

INDIAN AGRICULTURAL RESEARCH  
INSTITUTE, NEW DELHI.







# THE PRACTITIONER

THE LEADING MONTHLY MEDICAL JOURNAL

FOUNDED IN THE YEAR 1868

No 757. Vol. CXXVII, No. 1 -- JULY, 1931

Price 7/6

6-8 BOUVERIE STREET, FLEET STREET

87681



IARI

*Facts* WHICH *for* SPEAK THEMSELVES!

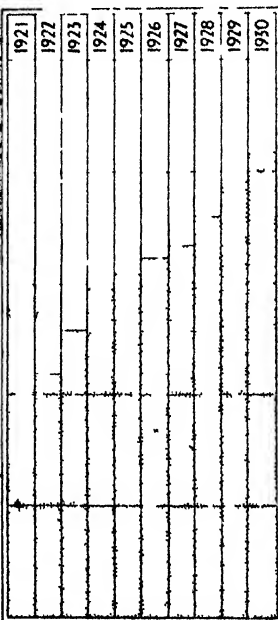


COW & GATE Milk Food is now supplied to almost every Hospital and Welfare Centre in this country although it is the highest priced food on the market.

We illustrate here a graph showing the COW & GATE sales growth during the last ten years.

**THERE MUST BE A REASON FOR THIS EXTRAORDINARY GROWTH!!**

It is because the Medical Profession has over a long period proved the value of COW & GATE, and insists on having the best!!



COW & GATE Sales Growth

Support Home Agriculture  
COW & GATE  
LIMITED is an all  
English Firm, using only  
home produced milk

"The best milk for babies,



Write for particulars  
of our special Milk  
Foods for difficult  
Infant Cases

when natural feeding fails"

**COW & GATE LTD.**

**GUILDFORD, SURREY**

FOR CONTENTS SEE OVERLEAF

---

**PRESCRIBE MORE KAYLENE !**

Since the introduction of Kaylene the adsorption treatment of putrefactive toxæmias has received increasing attention and to-day this method of ridding the bowel of toxins and noxious substances is recognised as a valuable addition to the medical treatment of gastro-intestinal disorders.

*Samples and "Adsorption" literature obtainable  
on request to :—*

**KAYLENE LIMITED,**  
**Waterloo Road, London, N.W.2.**

Telephone : Gladstone 1071.      Cables : "Kayloidol, London."  
Telegrams : "Kayloidol, Crickle, London."      Code : Bentley's.

---

## PRINCIPAL CONTENTS

(FOR DETAILED CONTENTS, SEE PAGES XXXII AND XXXIV)

### **INTRODUCTION**

By Sir Robert Jones, Bart., K.B.E., C.B., C.M.E., LL.D., F.R.C.S.

### **THE MODERN TREATMENT OF ACCIDENTAL INJURIES**

By Lorenz Böhler, M.D.

### **PRECEPTS IN TRAUMATIC SURGERY**

By John J. Moorhead, B.S., M.D., F.A.C.S. (D.S.M.)

### **THE TREATMENT OF OPEN FRACTURES**

By Ernest W. Hey Groves, M.S., F.R.C.S.

### **THE RADIOLOGY OF BONE INJURIES**

By H. K. Graham Hodgson, C.V.O., M.B., B.S., D.M.R.E.

### **GENERAL ANESTHETICS IN FRACTURES AND ACCIDENTS**

By C. W. Morris, O.B.E., M.B., B.S.

### **INJURIES AND FRACTURES OF THE SKULL**

By L. R. Broster, O.B.E., D.M., M.Ch., F.R.C.S.

### **FRACTURES OF THE SKULL IN CHILDREN**

By Cecil P. G. Wakeley, F.R.C.S., F.R.S.E.

### **INJURIES OF THE SPINE**

By Julian Taylor, M.S., F.R.C.S.

### **INJURIES TO THE SHOULDER**

By E. P. Brockman, M.Chir., F.R.C.S.

### **SOME COMMON FRACTURES OF THE UPPER EXTREMITY**

By E. Laming Evans, C.B.E., M.A., M.D., F.R.C.S.

### **INJURIES OF THE WRIST**

By R. Watson Jones, B.Sc., M.Ch.Orth., F.R.C.S.

### **INJURIES OF THE HAND**

By R. R. Kerr, M.B., F.R.C.S.

### **FRACTURES OF THE PELVIS**

By Sir William I. de C. Wheeler, M.D., F.R.C.S., F.R.C.S.I., Hon. F.A.C.S., Hon. M.Ch.

### **TRAUMATIC DISLOCATION OF THE HIP**

By Arthur Rocyn Jones, M.B., B.S., F.R.C.S.

### **THE TREATMENT OF FRACTURES OF THE FEMUR.**

By S. L. Higgs, M.A., M.B., F.R.C.S.

### **INJURIES OF THE KNEE-JOINT**

By Robert Ollershaw, M.D., F.R.C.S.

### **FRACTURES OF THE PATELLA**

By A. J. Cockkins, M.B., B.S., F.R.C.S.

### **FRACTURES OF THE TIBIA AND FIBULA**

By H. Platt, M.S., F.R.C.S.

### **INJURIES OF THE FOOT**

By Walter Mercer, M.B., F.R.C.S.E.

### **SPORTS INJURIES AND THEIR TREATMENT**

By C. B. Heald, C.B.E., M.A., M.D., M.R.C.P.

For appointments, see page lxxiv. For Editorial, Business and Advertisement Notices, see page lxxx. For Index to Announcements, see pages xxii, xxiv and xxvi.

*Now being widely prescribed for digestive disorders.*

ANTACID

# **BiSoDoL**

DIGESTANT

*Samples will be gladly sent to Physicians on request.*

**BiSoDoL Limited, 12, Chenies Street, London, W.C.1**

## PHYSIOLOGICAL TREATMENT OF CONSTIPATION



COMPOSED OF

**EXTRACT OF THE INTESTINAL GLANDS**  
which strengthens the glandular secretions of the organ.

**BILIARY EXTRACT**  
which regulates the secretion of the bile.

**AGAR-AGAR**  
which rehydrates the contents of the intestines.

**LACTIC FERMENTS**  
anti-microbial and antipoissonous action.

---

**IN TABLET FORM.**

---

**ITS USE DOES NOT LEAD TO HABIT.**

LABORATORIES  
**LOBICA**

*46, Avenue des Ternes, PARIS (17°)*

## **PRINCIPAL CONTENTS**

(FOR DETAILED CONTENTS, SEE PAGES XXVIII AND XXX.)

### **Chemotherapy in Cancer**

By W. BLAIR BELL, B.S., M.D., Pres.C.O.G., F.R.C.S., Hon. F.A.C.S.

### **The Relation of Dysentery Bacilli to Chronic Ulcerative Colitis**

By J. ARNOLD BARGEN, M.D., MURRAY C. COPELAND, M.D., and LOUIS A. BUIE, M.D.

### **Tuberculosis of the Larynx**

By SIR JAMES DUNDAS-GRANT, K.B.E., M.D., F.R.C.S.

### **The Importance of Laryngoscopy in the Diagnosis of Pulmonary Tuberculosis**

By R. SCOTT STEVENSON, M.D., F.R.C.S.E.

### **Concealed or Unobserved Mastoiditis**

By RICHARD WARREN, M.D., M.Ch., F.R.C.S.

### **Mastoiditis, Its Diagnosis and Treatment**

By H. NORMAN BARNETT, F.R.C.S.E.

### **Speech Disturbances in Cases of Parkinsonism**

By E. STOLKIND, M.D.

### **Fat Children**

By W. F. CHRISTIE, M.D.

### **Enterospasm, Spastic Colon, or Tonic Hardening of the Colon**

By T. STACEY WILSON, M.D., F.R.C.P.

### **Some Clinical Observations on Cancer**

By W. H. COSENS, M.R.C.S., L.R.C.P.

### **Practical Notes**

### **Reviews of Books**

### **Preparations and Inventions**

For Appointments, *see page lviii.* For Editorial, Business and Advertisement Notices, *see page lxiv.* For Index to Announcements, *see pages xx and xxii.*

***Now being widely prescribed for digestive disorders.***

**ANTACID**

# **BiSoDoL**

**DIGESTANT**

***Samples will be gladly sent to Physicians on request.***

**BiSoDoL Limited, 12, Chenies Street, London, W.C.1**

## PHYSIOLOGICAL TREATMENT OF CONSTIPATION



COMPOSED OF  
**EXTRACT OF THE INTESTINAL GLANDS**  
which strengthens the glandular secretions of the organ.

**BILIARY EXTRACT**  
which regulates the secretion of the bile.

**AGAR-AGAR**  
which rehydrates the contents of the intestines.

**LACTIC FERMENTS**  
anti-microbial and antipoissonous action.

---

**IN TABLET FORM.**

---

**ITS USE DOES NOT LEAD TO HABIT.**

LABORATORIES  
**LOBICA**

*46, Avenue des Ternes, PARIS (17°)*

## **PRINCIPAL CONTENTS**

(FOR DETAILED CONTENTS, SEE PAGES xxx AND xxvii.)

### **The Value of Post-Graduate Medical Education**

By SIR HENRY SIMSON, K.C.V.O., M.B., F.R.C.P., F.R.C.S.E., F.C.O.G.

### **Post-Graduate Education in London**

By R. SCOTT STEVENSON, M.D., F.R.C.S.E.

### **The Treatment of Pulmonary Suppuration**

By A. J. SCOTT PINCHIN, M.D., F.R.C.P., and H. V. MORLOCK, M.C., M.D., M.R.C.P.

### **On Urinary Obstruction**

By J. B. MACALPINE, F.R.C.S.

### **Diathermy in Urinary Surgery**

By ARTHUR JACOBS, F.R.F.P.S.

### **Ludwig's Angina**

By HAMILTON BAILEY, F.R.C.S.

### **The Diagnosis and Treatment of Coronary Thrombosis**

By G. S. HAYNES, M.D., M.R.C.P.

### **A Contribution to the Study of Intestinal Infection**

By J. SFAVELY DICK, M.B., B.Ch.

### **The Use of Artificial Pneumothorax in the Treatment of Pleurisy in Pneumonia**

By A. BRIAN TAYLOR, M.B., Ch.B.

### **The Wisdom Tooth and Associated Troubles**

By J. DUNLOP KIDD, M.C., M.B., D.M.R.E.

### **Tuberculosis and Goats' Milk**

By R. I. PITT, L.F.P.S.G., L.S.A.

### **Practical Notes**

### **Reviews of Books**

### **Preparations and Inventions**

For Appointments, *see page lxx*. For Editorial, Business and Advertisement Notices, *see page lxxvi*. For Index to Announcements, *see pages xxii and xxiv*.

***Now being widely prescribed for digestive disorders.***

ANTACID

# **BiSoDoL**

DIGESTANT

***Samples will be gladly sent to Physicians on request.***

**BiSoDoL Limited, 12, Chenies Street, London, W.C.1**



## PHYSIOLOGICAL TREATMENT OF CONSTIPATION



COMPOSED OF

**EXTRACT OF THE INTESTINAL GLANDS**  
which strengthens the glandular secretions of the organ.

**BILIARY EXTRACT**

which regulates the secretion of the bile.

**AGAR-AGAR**

which rehydrates the contents of the intestines.

**LACTIC FERMENTS**

anti-microbial and antipoissonous action.

---

---

**IN TABLET FORM.**

---

---

**ITS USE DOES NOT LEAD TO HABIT.**

LABORATORIES

**LOBICA**

*46, Avenue des Ternes, PARIS (17°)*





## Fractures and Accidents

### Introduction

BY SIR ROBERT JONES, BART., K.B.E., C.B., CH.M.,  
LL.D., F.R.C.S.

*Lecturer on Orthopædic Surgery, Liverpool University ; Consulting Orthopædic Surgeon to the Royal Infirmary, Liverpool ; Consulting Orthopædic Surgeon to St. Thomas's Hospital.*

HAVING been asked by the Editor to write a short introduction on fractures for this special number of THE PRACTITIONER, which comprises a group of important contributions, I have read the advance proofs of the articles, but, in any case, it would be out of place for me to offer any criticism on the opinions and practice of my distinguished colleagues. My remarks will, therefore, be general and must largely be a repetition of views I have so often expressed.

Whatever method we employ in the treatment of fractures, its object must be the restoration of complete function with the least risk and inconvenience to the patient, together with the least anxiety to the surgeon. To attain this end we should have constantly before us a clear idea of the disabilities and deformities which are commonly encountered in the neglected or inadequately treated case.

When we treat fractures of the long bones, more especially of the lower extremities, we must effect good alignment, not merely for æsthetic reasons but for the preservation of the joints which lie above and below. A correct alignment ensures the preservation

of the true axis of the joints, enabling the stresses of muscular action to act across the joints in normal line. In other words, we should make sure that body weight be directed so as to fall accurately upon the joint lines. Failure in this involves an abnormal stress and strain in accordance with the law laid down by Wolff, which is the physiological equivalent of the universal law that strain is proportional to stress.

The best results are obtained when correct apposition is achieved because, theoretically at least, this secures a correct alignment, and yet we know from experience that meticulous exactness in replacing fragments is not essential to a perfectly good functional success. We frequently meet with end-to-end contact with more or less angulation, and surgeons of experience know that this is a much more serious defect, from the point of view of function, than a slight overlap with a correct alignment. This is a fact to which I attach great importance. It is not an argument for the careless setting of a fracture, but is advanced in order to emphasize the value of the correct incidence of body weight.

In giving allegiance to this principle of treatment each surgeon must frame for himself his own rules of procedure and his own technique. One surgeon will trust to operative methods upon the seat of fracture and securing by plate, wire or bone peg. Others, experienced in manipulative methods, will have greater confidence in treating their fractures in this way and securing fixation by external splints. They will reserve operation for cases in which their manipulative skill has failed to secure a good setting. These schools of thought should not be looked upon as essentially antagonistic, but as rival methods which surgeons employ to obtain the same ends.

As my colleagues know, I rarely find it necessary to operate on the long bones; indeed I have never operated upon a recent case of fracture of the femur,

and very rarely have I had any shortening which could prove a functional disability. Consequently I can find no occasion to plan an open reduction. With others less experienced in manipulative and mechanical methods the problem must be attacked from another angle. The same is true of fractures of the humerus.

We should look upon every fracture as the potential cause of disability. Study of and recollection of the deformities in the neglected cases will help us materially to avoid mal-union. For example, in fractures of the neck of the femur we find an elevated pelvis, adduction and flexion with external rotation of the hip in addition to shortening. In treating the recent case, therefore, we must secure length by extension, and lock the fractured ends by internal rotation and abduction. This fracture is held in position by capsular tension further augmented by contact of the trochanter with the side of the pelvis, while in the sub-capital variety the fracture line will be included in the acetabulum. If we remember this, even if union is not consolidated, the classical deformities with their grave functional disability will not be encountered. In fractures of the upper third of the femur the proximal end is flexed and abducted, and the distal end is drawn upwards by the adductors. In such fractures, therefore, the limb should be extended and abducted. In fractures of the middle third there is often an obliteration of the normal convex curve which, if uncorrected, will give rise to a genu recurvatum. In the lower third of the femur we must guard against the prevalent sagging due to the action of the gastrocnemius which, if uncorrected, leaves a hyper-extended lower limb below the seat of fracture. Again, in the tibia we have characteristic deformities. In the upper third adduction of the lower fragment gives rise to a high bow leg, while obliteration of the normal tibial curve in fractures of the

middle and lower third produces a knock-knee and an everted foot. In Pott's fracture we know what tragedies arise from not effectively reducing the dislocation backwards at the ankle joint.

The common supracondylar fracture of the humerus when unreduced leaves the elbow more or less fixed below a right angle, and a bony block is met with when we attempt to flex the elbow. This is due to the displacement backwards of the lower fragment, while the upper fragment protrudes at the bend of the elbow, the result of inefficient reduction or faulty postural fixation. Our object, therefore, in a recent case should be to bring the lower fragment downwards and forwards and to correct any lateral displacement that may be present. When the reduction is effected the elbow should be kept at about thirty degrees of flexion in order to retain the fragments in position. The tense triceps muscle acts as a splint. It should be emphasized that mere flexion of the elbow without reducing the fracture is a puerile and dangerous practice. We could multiply these examples were it necessary, but enough has been said in order to show how important it is to bear in mind the common deformities following the various fractures.

I have often pointed out that textbooks are apt to mislead us as to the time needed for complete consolidation of a fractured bone; they understate the period. This is especially unfortunate when we deal with fractures of the femur. An examination of a large number of cases proved that even after three months, when consolidation seemed complete, body weight caused or increased shortening by pressure on the bone ends either by overlapping or by disturbing the correct alignment. To avoid this we protect the fracture, when the time for walking comes, by a caliper splint until union is unyielding. The splint is so fitted that it is a shade longer than the limb so that the heel does not touch the boot. The weight is,

therefore, transferred from the limb to the splint. Swinging the limb improves its nutrition and aids repair, for in a modified form it restores the physiological function of the limb. To ensure safety, from first to last, I allow six months. The splint is removed at night time. The knowledge of this fact has enabled me on many occasions to restore alignment in mal-union of many weeks standing by forcibly straightening the limb at the seat of fracture without open incision.

It is of importance to remember that the period of consolidation in fractures differs in individuals, and is also influenced by the age of the patient. In children it takes less time than in the adolescent, and in the adolescent less time than in the aged. It also varies in the same individual. In osteotomy at the upper end of each tibia, where apposition is accurate and fixation identical, consolidation may occur much more rapidly on the one side than on the other. It should also be noted that delay in union frequently occurs in fractures through thick compact tissue and gives rise to unnecessary panic. Fractures of the middle third of the humerus, tibia and femur are illustrative examples.

Delayed union must not be confused with true non-union. If delayed union is not adequately dealt with a permanently un-united fracture may result. Osteogenetic changes after a delay of many months may result in firm consolidation. As I have pointed out, there may be several weeks of apparent inactivity in callus formation followed by rapid consolidation. It behoves the surgeon to be patient. Many cases of true non-union occur from fear on the part of the surgeon who every few days examines a delayed union instead of keeping up uninterrupted fixation. Delayed union is favoured by inefficient reduction, by firm circular compression, or by faulty application of plaster of Paris. If length, apposition and alignment are maintained non-union should be extremely rare,



for under such conditions muscle cannot well interpose between the fractured ends. There is no proof that non-union is ever due to pregnancy, or any of the cachexias, general paralysis or rickets. Syphilis does retard consolidation, and a Wassermann test should be made with a view to treatment. Over-extension was the cause of non-union in many fractures of the humerus which occurred during the war. Stimulation of the bone ends and local congestion, as originally practised by H. O. Thomas, should be tried when delay occurs. This should be effected without disturbing the bone ends. Open operation should be reserved for true non-union.

The value of extension in obtaining a correct alignment cannot be overestimated, and there are various methods in which this can be brought about. Metal traction, used so much during the war, was employed almost exclusively on fractures of the lower extremity. These consisted mainly of calipers protected and unprotected, and pins of the Steinman type. Those were applied to the lower end of the femur, or to the head of the tibia in fractures of the femur, and through the os calcis or lower end of the tibia in fractures of the tibia and fibula. These methods of extension have come to stay, but perhaps I may be allowed to give a note of warning. Unless care is taken very serious damage may occur. I have seen many cases in which the calipers and pins have worked into the knee and ankle joints, several of which had become acutely septic. Many of these tragedies occurred in the hands of skilful surgeons, and it is well to appreciate that if the method becomes routine and is practised by men with but little surgical experience we may expect many serious happenings. They are indicated especially in oblique fracture of the tibia and in compound comminuted fractures of both femur and tibia. For simple fractures of the femur, and transverse fractures through the tibia

skeletal traction is not essential. In two military hospitals during the war over 300 fractures of the femur were treated without skeletal traction, and the average shortening, despite war wounds, was about half an inch. Efficient extension rapidly corrects any muscular spasm, and this is especially the case in fixed extension when the leg is pulled and the extension straps are tied to the lower end of the splint and tightened from time to time, in contrast to elastic traction exemplified by the weight and pulley—a form of extension I never use. Extension by weight and pulley is not an efficient method of attempting to control muscular spasm. It is by reflex nervous impulses induced by changes of tension in the muscle that muscular spasm is produced. A patient lying in bed with a fractured femur cannot avoid constantly changing the state of tension of the muscles of the thigh if he has a weight and pulley attached to his limb. The counterpoise is the weight of his body. Every time he tries to shift the position of his shoulders by digging his elbows into the bed he alters the tension of his muscles, calling forth a reflex spasm, not necessarily painful. When he falls asleep his muscles relax; when he is moved on a bed-pan there must be a reflex contraction of the muscles because there is a sudden change in tension.

The profession has of late been considerably influenced by the work of Böhler, who has contributed an interesting article to this number of *THE PRACTITIONER*. He has thrown the weight of his abundant experience into the conservative scale, and is as convinced as Thomas was upon the value of uninterrupted and prolonged rest in acquiring consolidation of bone. He also shows great ingenuity in effectively maintaining bones in apposition. His authoritative, dogmatic and lucid teaching must therefore hold and influence his audience. He says :

If we reduce exactly a broken joint and continuously hold it

in good position until union has taken place, and at the same time allow the use of the fractured extremity we obtain a movable joint, while on the other hand if we apply massage and passive movements in the first days after the fracture the joint becomes stiff. . . . Active movements are in every respect preferred to passive movements. . . . Muscles can work and contract without their points of origin and insertion approaching each other.

This is clear and emphatic teaching which will find its echo in our experience and practice during the war, for we discarded all apparatus of the Zander type, and encouraged active movements in muscles without moving the injured joint, especially in the use of the quadriceps. It is also borne out by the development of muscles in fractures of the femur by the ambulatory use of the caliper. Böhler is equally opposed to the mobilization of fractures as practised by Lucas Championnaire, as he is to the immobilization by plating. Of the latter procedure he says :

The most disastrous innovation in the treatment of fractures is the operative reduction of the latter, and the fixation of the fragments by the use of large metallic foreign bodies. Thousands of lives have been sacrificed on account of this procedure, and still more have been crippled.

Whether this criticism is unrestrained or not, Böhler has done a great service in again emphasizing principles, many of which he admits are old, and in giving us practical help in many types of fracture, notably the carpal scaphoid and the os calcis. We are all grateful to him for the lessons he has taught us in the relief of pain and spasm by the injection of novocain into the hæmatoma surrounding the fractured ends.

Böhler has gained his large experience by his attachment as Chief Surgeon and Director of the Vienna Accident Hospital. This leads me to say a few words on a matter referred to by Hey Groves, which has interested me for many years. With the advent of the motor and increase in road traffic the casualties in civil life have been enormously increased. In war we lost over a million killed and two and a

half millions wounded. Between 1918 and 1930 our peace casualties have been 30,000 killed and five millions injured. Our hospitals have been overcrowded both in the large cities and in the country. As Hey Groves says, these cases are often necessarily inadequately treated. It is a great opportunity for turning our municipal hospitals to good use. In 1925, in an address on "Crippling due to Fractures,"<sup>2</sup> drawing attention to the fact that great numbers of cripples were manufactured by want of adequate provisions, I said :

If our city hospitals admit they cannot cope with the problem for want of beds, room should be procured in municipal infirmaries or other institutions. These hospitals should, however, be fully staffed and equipped and brought into close association with our teaching centres, but whatever the arrangement the student should should have the full benefit of it.

As Hey Groves states, there is now a great opportunity in the reorganization of our municipal hospitals. In every large city we should have a fracture hospital fitted to deal effectively with every accident. In an address delivered to the College of Surgeons of America in 1919<sup>3</sup> I said :

A more systematic and thorough education is required in the treatment of fractures. This can only be effected either by setting apart wards for fractures under the care of men who devote real interest to the subject, or by retaining certain institutions solely for the treatment of these cases. Education is sure to be imperfect if the treatment of fractures is to remain in the hands of surgeons who take no interest. In England, and I should imagine in America, the demand for beds is so pressing in our civil hospitals that a junior officer will gain no favour if fractures are admitted in numbers, or are retained for long. This, after all, is only the story of early evacuation in time of war. It has no justification in time of peace. If general hospitals are not prepared to segregate cases of fracture, properly superintend them, and treat them until evacuation is safe, they are far better without them, from the point of view of the surgeon, the student and the patient.

When we consider the enormously increased number of accidents occurring to-day the necessity for segregation and accommodation is more than ever urgent, and the education of students in the principles of the

treatment of fractures is essential.

If I were a dictator and asked to deal with industrial accidents I should adopt a plan on the following lines :—

(a) Utilization of a municipal building for industrial accidents with special staff and equipment. This hospital should be in touch with a teaching centre and should be found in each city.

(b) A Fracture Clinic should be attached to each teaching hospital, and fractures should be segregated in the wards. They should be in close association with the fracture hospital.

(c) First aid splints should be standardized and every student taught their application.

(d) The staffs in small country hospitals should be effectively trained in first aid, and the hospital should be used as a casualty clearing station.

(e) Ambulances organized and multiplied to give first aid, and well supplied with splints should be placed within easy access. There are already several in existence under the auspices of the Red Cross and the Order of St. John of Jerusalem. This is a very essential adjunct, for with a well trained team many deaths from jolting and shock would be averted. We must remember that during the great war the deaths from compound fracture of the thigh were reduced from 80 per cent. to 20 per cent. when the ambulance with the necessary splints reached the firing line.

#### References.

<sup>1</sup> Böhler, Lorenz : "Treatment of Fractures," Vienna, 1929.

<sup>2</sup> Jones, Robert : "Crippling due to Fractures." Lady Jones Lecture, Liverpool University. *Brit. Med. Journ.*, 1925, i, 909.

<sup>3</sup> *Idem* : "A few Surgical Lessons of the War." An address to the American College of Surgeons. *Brit. Med. Journ.*, 1919, ii, 587.

# The Modern Treatment of Accidental Injuries

By LORENZ BÜHLER, M.D.

*Director of the Accident Hospital, Vienna.*

INDUSTRIAL development, in particular the growth of traffic, is the chief cause of the yearly increase in accidents to life and limb, and in consequence the treatment of injuries is assuming an ever-growing importance. Open wounds, fractures and joint injuries are the commonest accidental causes of permanent disability and invalidism.

## OPEN WOUNDS

The chief danger of open wounds is the occurrence of severe progressive infections which not infrequently have a fatal issue. This, however, can be avoided in most cases if the wound is treated at the earliest possible moment, that is, within six to ten hours, by clean excision and primary suture. Excision is best carried out under local anæsthesia.

When the anæsthetic solution, e.g. novocain, is injected under the unbroken skin in the direction of the wound, a quantity escapes into the wound and floods out a certain amount of dirt. On the other hand, if the anæsthetic is applied direct to the wound itself, this dirt is often pressed deeper into the tissues. It is of importance to clean away with knife and scissors all injured and mortified tissue—not the skin alone. Next, the skin must be closed with thick sutures. With the exception of the larger nerve trunks, the deeper lying tissues should not be sutured, in order to avoid forcing any foreign body away from the periphery. Tendons should be sutured only in the case of sharp incised wounds and not when they have been injured by crushing. Tetanus anti-toxin must be given as a

prophylactic in all unclean wounds.

It is very dangerous to suture any wound before it has been most carefully excised; anærobic infections, tetanus, gas gangrene and progressive cellulitis may otherwise be the sequel. When the wound has been carefully excised and the skin sutured, the injured limb must be fixed in splints or a plaster of Paris bandage, with a "window" to allow of open treatment.

If bandages are applied to a severely damaged surface they become moist with blood and exuded serum, and so macerate the skin. The result is that infection penetrates through the suture holes to the subjacent tissues, and may affect exposed tendon sheaths, joints and bones. On the other hand, if the wound is left unbandaged the exuded blood dries to form a protective crust.

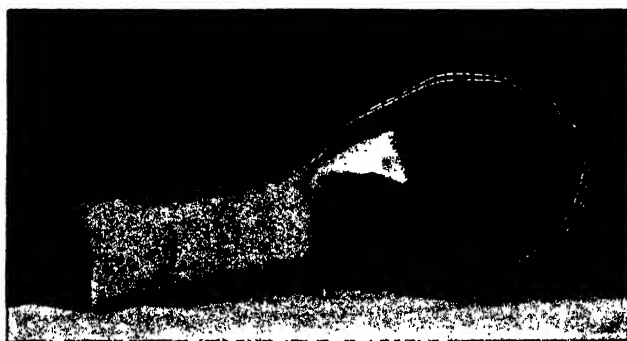


FIG. 1.—Compound fracture of the first metacarpal. The edges of the wound were accurately trimmed and then the skin alone sutured. Wire extension applied through the skin of the pulp of the thumb. Open wound treatment.

To promote good circulation the injured limb must not only be fixed but also raised: Braun's splint is most suitable for the leg and an abduction splint for the arm.

Thus the essentials for the treatment of an open wound are: (1) Careful excision; (2) exact skin apposition by suture; the deeper structures, with the exception of the larger nerve trunks, not being sutured; (3) good fixation of the damaged part of the limb;

(4) open treatment of the wound; and (5) raising the injured part.

#### FRACTURES AND JOINT INJURIES

Next to wounds the most important aspect of accident surgery is the treatment of fractures. The basic idea of the treatment of fractures can best be grasped if one first considers the function of the bones. Bones are the internal supports of the body and of the limbs. When a bone breaks, the associated tissues lose this support, and therefore a substitute must be supplied (after the bones are placed in position) and maintained until the fractured parts are firmly re-united. All treatment of fractures therefore requires : (1) Exact apposition of the fractured parts ; (2) prolonged fixation of the opposed parts in good position until they are re-united. Any treatment which does not fulfil these two postulates is foredoomed to failure.

All improvements and innovations can therefore only aim at simplifying and eliminating risk from these two procedures; apposition and prolonged fixation. The following are the innovations of recent years which have markedly facilitated the apposition of fractures, and in many cases have for the first time made this possible :—

(1) The use of local anæsthesia by injection of a solution directly into the wounded tissues and between the fragments of the bone.

(2) The application of traction by means of skewers, wires or “ tongs ” applied directly to the bones.

(3) The use of screw tension in association with flexion of the joints, to bring about relaxation of the muscles (Fig. 2). Fraction with the screw to produce tension has been known for hundreds, if not thousands of years.

Muscular cramp is always the greatest impediment to good apposition, because after every fracture the muscles lose their counterpoise. This cramp is always



caused by pain, and disappears as soon as the sensation of pain is removed. When an anæsthetic solution is

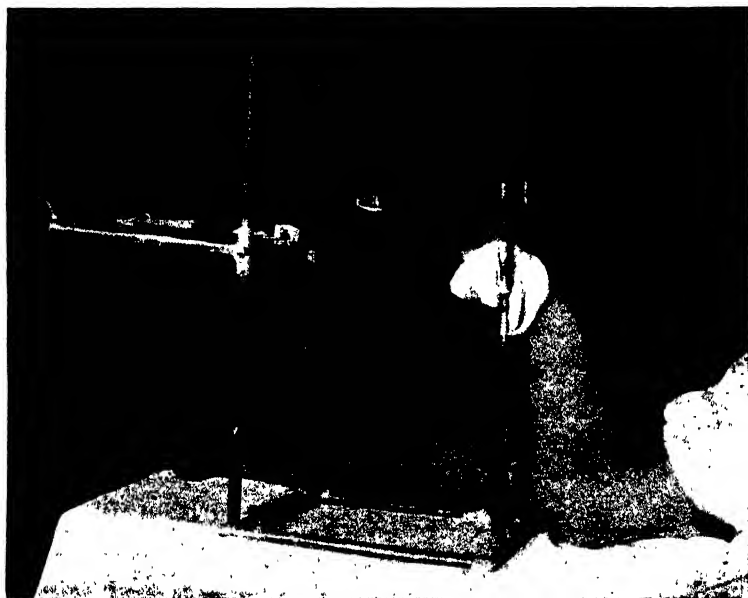


FIG. 2.—Apparatus with screw tension for fracture of tibia. The right angle position of the knee joint removes tension from the tendo achilles.

injected into the extravasated blood bathing the fractured ends and the soft parts, there is immediate cessation of pain and dramatic disappearance of the cramp. Then, when the muscles are relaxed by flexion of the joints, it is almost always possible to attain good apposition of the displaced ends by means of screw traction applied direct to the bone.

A 2 per cent. novocain solution is the most suitable for local anæsthesia. When the fracture has been accurately located, the injection needle is inserted as far as the bone and 5 c.cm. of the 2 per cent. novocain solution is injected. The syringe should then be removed from the needle; if the solution that wells out is red coloured, it means that the injection has been properly made into the extravasation. If the solution is clear, further exploratory attempts are necessary until the extravasation is found. I have used local

anæsthesia for fresh fractures in more than 5,000 cases.

It is a much more difficult business to maintain the opposed ends in good position until the bones have knit than it is to secure good apposition. The continuous pull of the muscles and the action of gravity tend to produce recurrent malposition, especially if the fracture is splintered or diagonal, and in such cases it is impossible to maintain good apposition with wooden or metal splints, or with plaster of Paris. The best method for the prolonged setting of many fractures, especially those of the femur, is continuous traction direct on the bone with skewers, "tongs" or stretched wires. A new development consists in the use of skewers or wires passed through the bones both central and distal to the fracture and retained in position



FIG. 3.—Apparatus for fracture of forearm employing traction and counter-traction. A stainless steel wire is passed through both bones proximal to the wrist and through the ulna alone at the elbow.

with unpadded plaster of Paris bandages. In this way correctly apposed ends are bound up directly with the plaster and subsequent slipping is eliminated. At present this procedure has been worked out for fractures of the forearm, wrist, tibia, and ankle bones, and for various dislocations of the bones of the foot.

In fracture of the forearm, for example, the *modus*

*operandi* is, having anæsthetized the brachial plexus, to pass one stainless steel wire through both bones above the wrist and another through the olecranon at the elbow (Fig. 3). Over that an unpadded plaster splint is applied to the extensor aspect of the forearm and upper arm, and a second splint to the flexor aspect of the forearm. On top of these a plaster bandage is applied (Fig. 4). By this method the broken ends are



FIG. 4.—Plaster of Paris cast complete, in fracture of forearm. Both wires are firmly held in position by the plaster.

actually incorporated in the plaster of Paris, thus rendering further malposition impossible. Figs. 5 and 6 show the position of the fragments before and after setting.

Operative exposure of the fragments in order to secure union with plates, screws, wiring or splicing, always involves certain dangers, secondary infection particularly, and should therefore be avoided in most cases. However, this procedure is imperative in certain fractures, where the fragments have become separated, as, for example, in fractures of the patella and olecranon.

For medial fracture of the neck of the femur, Smith-Petersen's skewer is to be recommended.

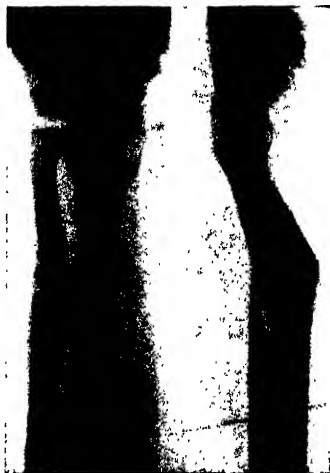


FIG. 5.—Severe splintered fracture of the forearm, before setting.

It has only recently been realized that in many types of fracture the duration of the healing process is



FIG. 6.—The same fracture as Fig. 5 after setting. The two wires passing through the bones are visible.

much longer than was hitherto supposed, and further that many fractures which were considered almost beyond hope of re-uniting, such as those of the neck of the femur, and of the navicular bone of the hand, may unite if immobilized for a sufficiently long period. Fractures of the navicular bone will always unite if they are immobilized in an unpadded plaster of Paris bandage and not disturbed for six weeks or longer. In about 150 fresh navicular fractures that I treated in this way I obtained bony union in every case.

As too prolonged immobilization damages the organs of movement, it would be desirable to find some means of shortening the time of bony consolidation. All chemical agents hitherto tried have given negative results, whether applied internally, subcutaneously, or injected between the fragments. On the other hand, the mechanical process of drilling holes, as indicated by Beck, has proved of value in delayed callus formation and in pseudo-arthritis.

Beck's "boring" method, applied, for example, to a pseudo-arthritis of the tibia, is carried out as follows: two points of insertion for the augur are made both proximal and distal to the fracture and through these are drilled about 30 to 40 holes which pass from one fragment to the other. This drilling brings the marrow space of both fragments into contact, and the holes fill with blood, bone detritus and marrow—that is, with material for callus formation. The most important point, however, seems to me to be that these holes open up new channels for the blood-vessels in the sclerosed bone of the fractured ends. I have employed this method in over 50 cases, and in the majority the result was successful.

If fractures are properly handled from the start, subsequent after-treatment is usually unnecessary. In order to grasp the principles of after-treatment, it is essential to realize the nature of the disabilities that may arise. These may be summed up as follows:

Non-union of the bones, distortion, shortening and twisting of the limb, stiffness or limitation of movement and pain in both adjacent and remote joints, muscular atrophy and prolonged swelling. All these conditions may cause temporary or even permanent disability as a sequel to a fracture.

The usual after-treatment consists in the application of physical methods, such as massage, active and passive movements by manipulation or by means of instruments. Electricity, galvanic or faradic, may be employed, or warmth may be applied in the form of hot air, hot baths, fomentations, diathermy and so forth.

Many surgeons commence the after-treatment when the bones have knit, while others make a start during the first days after the injury.

Such measures, however, are of no avail where the bones, once united, are shortened, twisted or deformed, and they can improve limitation of movement only when the cause has been unsuitable and over-prolonged immobilization, not where mal-apposition of the fragments in a fracture of, or near, a joint was responsible. Thus the field of physical after-treatment is a very limited one, and the obvious conclusion is that a fracture should, from the first, be set in such a way that the usual disabilities may be avoided, leaving "after-treatment" to cope with a few minor sequelæ only. To obviate, as far as possible, all untoward results from the very beginning is more important than to run the risk of costly and tedious after-treatment in the attempt to rectify errors.

Shortening and twisting can only be avoided by accurate apposition of the fragments and by maintaining them in a good position until the bones are knit. By accurate apposition and prolonged fixation of the fragments the affected limb remains free from pain, and those parts which are not fixed may be suitably induced to function. If active movements are systematically carried out no muscular atrophy or ischæmia

ensues. By raising the arm with a double right angle splint and the leg with a Braun's splint, traumatic swellings are dispersed and subsequent swelling prevented.

Ankylosis, especially in joint fractures, is best circumvented by taking the greatest pains to ensure accurate apposition, and by avoiding too early movement of the broken section of the limb, in order to obviate subsequent malposition.

Passive movements and massage are particularly harmful, since such measures can only be carried out if the firm plaster bandages are removed, thus disturbing the immobility of the limb. The result will be that fractures which were originally in mal-apposition would revert to their original state, and again in many types where the nutrient supply is poor, massage and passive movement prevent calcification and so cause a pseudo-arthritis. This is the case, for example, in fractures of the neck, of the femur, or of the navicular, also in transverse fractures of the tibia or radius.

The fear that prolonged immobilization of a section of a limb may lead to permanent stiffening is unfounded, since it is possible to work the muscles and cause them to contract powerfully without movement of the articulating surfaces. For example, although the knee is fixed in extended position the quadriceps can be powerfully contracted and the patella moved freely. If the wrist is immobilized, as in fracture of the radius, all 40 muscles of the hand can be actively exercised and the tendons of the fingers can move actively in opposition through two inches. That is, the hand can function, and the muscles will not atrophy.

On the other hand, if the wrist is not immobilized after fracture of the radius, there is constant pain. Movement is therefore avoided, the dorsum of the hand swells, the muscles and bones atrophy, the fragments slip from position, and there follows a permanent limitation of wrist movement.

I maintain, therefore, the following somewhat paradoxical thesis :

*If a fractured articulation is accurately set and is maintained in undisturbed immobility until the bone has knit, while at the same time the broken limb is actively exercised, a freely movable joint is obtained ; on the other hand, if massage and passive movement is applied from the first day of the injury, the result is ankylosis.*

I thus consider massage and passive movement in the early stages to be very harmful, because this treatment necessitates the undoing of the immobilization, so that well apposed fragments slip out of position. Further, passive movement and massage can be carried out only once or twice for a quarter of an hour per day. There are 96 "quarters of an hour" in the 24. As against that, when the limb is immobilized, the fingers can be actively exercised for hours on end. Yet when muscular atrophy, swelling and limitation of joint movement persists *after* knitting of the bones, then (but not till then) light massage and passive movement can be of valuable aid.

The question of the patient's age must here be stressed. In those under 20 years of age, provided the joint itself is not destroyed, permanent limitation of movement never occurs, even if the joint has been set maladroitly, and the usual after-treatment measures omitted. That is, if with massage and passive movement we obtain complete function in the joint of an adolescent, this success cannot be ascribed so much to the after-treatment as to the fact that we cannot, whatever method we employ, cause permanent ankylosis in a youthful joint, provided it has not been destroyed or become infected. With old people the matter is very different—a short immobilization in an unsuitable position (e.g. flexion of the hand) may lead to permanent disability.



# Precepts in Traumatic Surgery\*

By JOHN J. MOORHEAD, B.S., M.D., F.A.C.S. (D.S.M.).  
*Professor of Surgery, New York Post-Graduate Medical School,  
Columbia University.*

IN every branch of surgery there are certain axiomatic vital clinical facts, definite conclusions, identical experiences, parallel deductions. These rate almost as infallibles, they virtually constitute our creed, they are guide posts to diagnosis, treatment and prognosis. Strangely enough in traumatic surgery, the most ancient of all forms of surgery, we are still in disagreement as to some of the basic essentials, especially as to traumato-therapy.

A survey of the traumapathies brings the realization that 80 per cent. of the lesions encountered comprise : (1) Wounds, (2) burns, (3) fractures, (4) joint injuries, such as sprains, synovitis and dislocations. If we thus visualize and delimit this field of traumatic surgery and focus our attention thereon, we may attempt a survey with a view to collating a series of non-controversial precepts that may be helpful in clarifying a somewhat foggy vista.

## (1) WOUNDS

(a) Every wound not made with surgical intent is already infected, and the main problem is, therefore, the treatment of *infected wounds*.

(b) There are only two methods of sterilizing any wound; namely, by mechanical, or by chemical means. We adopt mechanical means when we cleanse with soap and water, and by non-sacrificial *débridement*. We adopt chemical means when we apply to

\* From the Department of Traumatic Surgery, Post-Graduate and Reconstruction Hospital, New York.

the wound some antiseptic. As to these, we must remember that proper mechanical cleansing is the basic preliminary, and we cannot rely solely on any vaunted antiseptic despite propaganda, colourful appearance or clever advertising. Abundant experience has shown that any antiseptic capable of killing organisms *in vivo* also kills the tissues, and thereby renders inert the very inherent qualities we seek to promote and protect. In every age there has been a grand hurrah as to some "new antiseptic" guaranteed to solve this problem of wound infection. Just now we are passing through a phase in which gaudy colours are the vogue, and we are importuned gaily to paint or daub our wounds because the present style of organisms prefer more sombre shades than did their predecessors. This is chromatic rather than traumatic surgery, and has no real nor lasting basis.

(c) Drainage is important in accidental wounds, and gauze should not be used because it soon acts as a plug. Taxidermy is not good surgery.

(d) Delayed or primo-secondary suturing is a safety-first principle which should be more diligently practised, especially in stripping-up or contused lacerated wounds. Hence, after cleansing, we place but do not tie the sutures until the end of the second or third day, in the interval covering the wound with a gauze dressing soaked in some proven antiseptic. Our personal routine choice is one dram of the tincture of iodine to one pint of normal saline solution (referred to as "I.S. solution"). Probably sterile gauze would do just as well if the wound has been properly cleansed, the blood clot removed and the frayed edges excised.

(e) Tetanus antitoxin should be used whenever soil contamination so indicates, and in all gunshot wounds. If given slowly in saline solution dilution there will be little anaphylactic reaction. Combined sera, such as anti-tetanic and anti-gas-gangrene, are as yet insufficiently standardized to enter the precept class.

(*f*) Rest, elevation, splintage and infrequent dressings are a quartet rendering wound healing more melodious and less malodorous.

(*g*) Infection occurring within the first three days is probably primarily due to the initiating trauma; occurring thereafter it is probably secondarily due to reinfection from imperfect initial cleansing or introduced infection from too zealous or improper dressings. The life cycle of the usual pus-producing organisms averages three days, so that the onset of infection with this known period of incubation should not be difficult to determine.

(*h*) Operations for infected wounds should be postponed until there are focal manifestations such as local fluctuation, tenderness or induration. This focalization is aided and abetted by the use of hot wet gauze dressings, moistened in saline or magnesium sulphate solution, and kept hot by an electric bulb, and kept moist by a perforated rubber tube inserted between the many-layered gauze dressing. This to be sure is like the old fashioned poultice; but it does focalize, and it is efficient. No incising is in order for generalized swelling, redness nor induration (cellulitis); and above all, interference is inadvisable for lymphangitis and lymphadenitis, especially along the pathway of red streaks.

When incision is decided upon, let it be deep enough and long enough to provide self-gaping so that self-drainage will occur without the necessity for gauze packing. If gauze is used for hæmostasis or ballooning purposes, let it be lubricated with vaseline or albolene so that it will not become adherent. An ordinary rubber band or a sectioned rubber glove will make an excellent drain; if a stiffer drain is needed, as in a pocket, a pipe cleaner will be useful.

(*i*) Secondary suture will cut short a long granulation period in many wounds; likewise pinch grafts are quite effective for the same purpose. Both procedures

are local anæsthesia problems, using novocain (1–2 per cent.) or an equivalent, with or without a preliminary dose of luminal (1–5 grains) or morphine ( $\frac{1}{8}$ – $\frac{1}{2}$  grain).

## (2) BURNS

The thermal effect is the essential, and in reality every burn can be regarded as a wound of thermal, chemical or electric origin, irrespective of the source.

(a) Pain is relieved by morphine or luminal, and some anodyne should be a routine of treatment.

(b) Dressings of sodium bicarbonate (5–10 per cent. solution) are applied at once, and a perforated rubber tube is enmeshed in the dressing so that re-moistening is accomplished without replacement of the original dressings.

After two to three days the stage of *dermatitis* is followed by the stage of *secretion*, and now the part is exposed to the open air or to an electric bulb (60–100 watts) for increasingly long periods. In the intervals of this exposure seance, the area is covered by gauze soaked in vaseline, albolene, or equal parts of sterile olive oil and camphorated oil.

When the third or *cicatrizing* stage is reached, the exposure is practically continuous, especially if the area is covered by a wire mesh or some other form of glorified “vaccination shield” device. We use “Celoglas” for this purpose because the violet rays are not intercepted; this material is a narrow wire mesh impregnated with acetone-cellulose and is used by chicken fanciers as a substitute for glass. Tannic acid (3–5 per cent.) is used by those who prefer to obtain a chemical *débridement* or tanning effect; but to be effective, it should be employed from the outset and the surface must be oil-free.

(c) *Débridement* should be reserved for selected burns under selected conditions, preferably localized third degree burns.

(d) Contractures are anticipated, and hence by

posture and exercises, every effort is made to prevent their occurrence, notably in such regions as the neck, axilla, bowel, groin and knee.

(e) Forcing fluids, especially in children, is an important element of treatment.

(f) Skin grafting and plastics should be early rather than late phases of treatment when the circumstances permit.

### (3) FRACTURES

(a) Bones are the shaped equivalent of soft parts, rendered thus by calcium.

(b) A fracture is a wound of bone, and as in other wounds there are two general groups or types. A type I fracture is one in which the bone edges are not end to end due to overlapping. A type II fracture is one in which the bone edges are end to end and there is no overlapping. Either of these may be simple (closed) or compound (open), and the direction of the fracture lines may be transverse, oblique or alphabetical. Obviously a type I fracture corresponds to a lacerated and a type II fracture to an incised wound.

(c) The essential object in treatment is to convert a type I (overlapping) into a type II (non-overlapping) fracture; in other words, our side-to-side anastomosis is to be converted into an end-to-end anastomosis.

(d) Traction and manipulation are the essentials and there are only two available methods at our disposal; one is manual, the other mechanical.

(e) Early reduction means easy reduction, and if we realign within the first few hours we are treating the fracture alone; if thereafter, we are treating the fracture plus complications.

(f) "Secondary swelling" is an index of circulatory stasis due more often to delay than to the original trauma; hence it is not a necessary but an avoidable evil.

(g) Provisional traction is always applicable, and

we should adopt some simple means of providing same during the waiting period between our first visit and the time of definitive setting. This means that in the hospital or the home we should at once attach to the ankle (Fig. 1) or the wrist *some* traction device that will effectively prevent muscular contraction during an enforced waiting period. A sheet or towel fastened to the ankle or wrist is a simple device, and if now the limb is placed on a pillow and the foot of the bed elevated, it only remains to attached a weight to the sheet or towel, and thus we have applied the principle of traction and counter-traction. In hospital,



FIG. 1.—Improved traction about ankle for fracture of the lower extremity.

a boot or gaiter, adhesive straps or a glued sock may be substituted; but the point is that *some* sort of traction is applicable even amid the most desolate or destitute surroundings. Over-night traction of this sort will usually convert a type I (overlapping) into a type II (non-overlapping) fracture.

(h) X-ray examination should be used more for the purpose of proving the success of setting than for the purpose of proving the success of diagnosis. We are rapidly losing our special sense organs from disuse, and assuredly by inspection and palpation we should be able to diagnose a bony from a non-bony enlargement in the vast majority of injuries. Prior to 1895,

X-ray diagnosis was unknown, and yet our predecessors did a pretty good job in the average fracture, even though automobiles and aviation have introduced a much more varied type of traumapathy.

(i) In any recent joint injury associated with deformity and disability, suspect fracture and not dislocation in 80 per cent., the shoulder alone excepted.

(j) In a type I (overlapping) fracture the diagnosis is made by the sense of sight almost invariably, the presence of bony deformity being the main feature. Dislocation should be the only confusing factor.

(k) In a type II (non-overlapping) fracture the diagnosis is made by the sense of touch almost invariably, the absence of bony deformity being the main factor. Contusion-sprain is to be differentiated, and in this the pain is anywhere and everywhere; in a non-displaced fracture it is just there and right there. In a type II fracture it is focal and local; in a contusion-sprain it is general and vocal.

(l) In the fracture lexicon there are four R's on the road to fracture knowledge, and these are: (1) Recognition or diagnosis, (2) Reduction or setting, (3) Retention or Splinting, (4) Refunctioning or rehabilitating.

(m) Splints should be safe and they should be simple, and no splint however elaborate can do more than hold the fracture in position; hence it is supreme folly to apply permanent splintage before resorting to setting. Every splint should fit the patient, and not the patient the splint.

(n) Moulded two-piece plaster of Paris splints have a very wide range of usefulness, and should be more often employed. They enhance circulation, they are removable for inspection and physiotherapy, they are custom made, they can be used from start to finish.

(o) Walking calipers (leg irons) permit earlier ambulation and shorten the crutch-bearing and disability period.

(p) Splints are removed in part when the stage of firm (lead pipe) union is reached, and they are discarded when the stage of solid (iron pipe) union is reached. This means that the calendar is not the index, but that the condition of the callus repair is the proper guide, realizing that nature's concrete (callus) is a variable factor as to production and as to consolidation. Splints should not be used indefinitely, otherwise it takes as long to recover from the treatment as from the fracture.

(q) Usage is permitted when certain "tests" produce no reaction in terms of prolonged pain, heat, swelling or redness. Forcible massage and resistive exercises are the essence of these "tests," and here again the condition and not the calendar is the best guide.

(r) Rehabilitation by massage, motion and exercises should be a coincident and not a late phase of treatment; hence physiotherapy should not be a phase of "after-care" but in reality a part of concurrent care.

(s) Compound fractures should very rarely be treated by primary suture, but on the contrary primo-secondary or delayed suture (as described above for "wounds") should be practically routine.

(t) The use of metallic suture material in fracture surgery, should be reserved for selected cases under selected auspices, and indeed bone surgery, like soft part surgery, has already entered the stage where non-absorbable material is rarely necessary or advisable.

#### (4) JOINT INJURIES

In all of these, early rather than late motion best promotes recovery. Hence the attack is mobilization rather than immobilization; open warfare rather than trench warfare.

*Sprains.*—At the outset, alternate soaks of hot and cold water followed by massage and suitable strapping (Fig. 2) and immediate usage, often permit the patient to resume the usual occupation at once. In the inter-



mediate or late stage, the use of hot soap suds compresses, followed by massage with warm camphorated oil, followed by exposure to the heat and light rays from electric bulbs is an excellent procedure. This is so routine with us in joint, muscle and tendon injuries that we refer to it as "SOL": S for soap, O for oil and L for light, each act of the triad to be used for ten minutes twice daily or oftener.

*Synovitis*.—We believe in immediate aspiration, thereafter continuing the treatment as for a sprain.

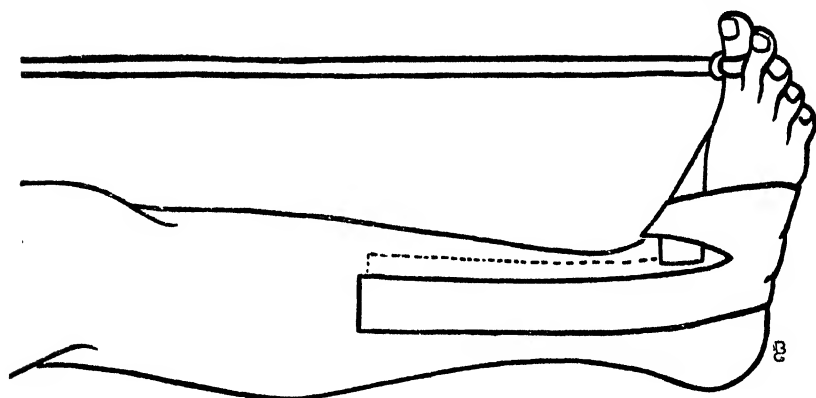


FIG. 2.—Ankle sprain : the "split" adhesive plaster strapping.

In the knee we visualize the joint as the face of a clock (Fig. 3), the XII mark on top centre, the VI mark at bottom centre. To aspirate, we paint the joint with iodine at the outer margin and then use a local anæsthetic over an area about one inch in diameter. In the right knee we enter the aspirating needle (with a calibre the size of the lead in a pencil) at IX, and pass to XII. In the left knee we pass from III to XII. After all the available fluid is withdrawn (and it is usually blood) we seal the puncture with sterile adhesive or collodion and strap the articulation with adhesive, purposely not encircling completely lest circulation is interfered with. Thereafter walking is permitted, and daily use of the "SOL" treatment is prescribed. In football injuries and the like, we have

found this method exceptionally efficient. Recurrent synovitis, especially from indirect violence, is often an index of intrinsic involvement, such as cartilage injury or some other form of joint calculus (fat pads, hypertrophied synovial tabs or osteochondritis dissecans, for example). Obviously such a repeated

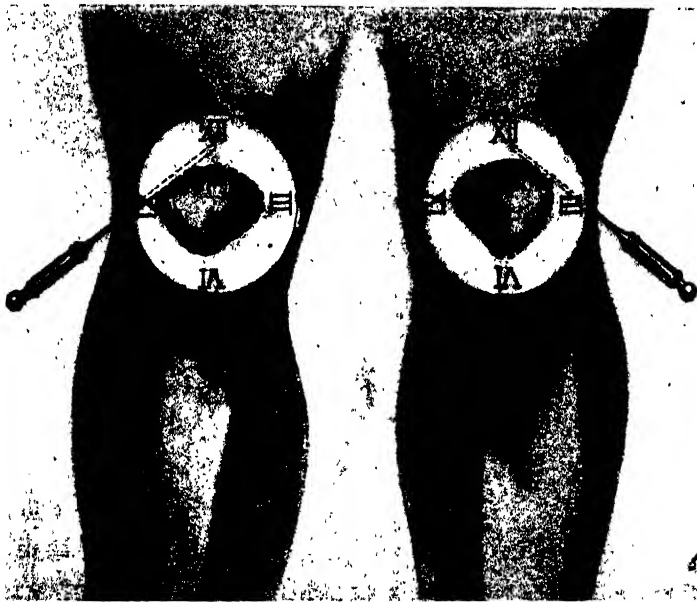


FIG. 3.—Synovitis of knee : the face-of-the-clock method of aspiration.

sequence may require arthrotomy, and for this we prefer a medio-lateral large incision rather than a small sub-patellar incision.

*Dislocations.*—As in fractures, early replacement means easy replacement and hence immediate treatment should be given. If for any reason this is inadvisable or inappropriate, provisional traction is a feature of value just as it is in fractures. Immobilization should not cause constriction, for after the dislocation is reduced, we are in effect treating a residual arthro-synovitis and capsule laceration.

# The Treatment of Open Fractures

BY ERNEST W. HEY GROVES, M.S., F.R.C.S.

*Professor of Surgery at the University of Bristol ;  
Surgeon to the Bristol General Hospital.*

THE need for carrying out team-work in the treatment of fractures becomes more urgent every day. It was the perfecting of team-work in the war which made it possible to reduce the mortality of gunshot fractures of the femur from 80 to 10 per cent. It is the lack of team-work in the civil hospitals of England which accounts for the high proportion of civil accidents which end in loss of limb or of function. By team-work in fracture treatment I mean the creation of special hospitals or special departments where all difficult cases may be sent and where surgeon, assistant surgeon and nursing staff may all concentrate upon this subject and create a high ideal of practice and a high standard of teaching.

At present fractures are admitted but not wanted in the wards of surgeons who are mainly concerned in abdominal surgery. Such cases are often inadequately treated and then sent out to some other institution for recovery. There is now, I believe, a great opportunity in the reorganization of our municipal hospitals for the creation of good fracture departments, which, if staffed by keen men, might raise the whole subject to the importance it deserves. There is urgent need of some wise and impartial authority to advise the Health Ministry in this matter. It is true that the 1929 Act legalized the full co-operation of the voluntary and municipal hospitals, but it needs something more powerful than benevolent permission to break down the barrier between these two classes of hospitals. It should be possible for every county and municipality to have one first-rate fracture centre to which bad and

difficult fracture cases could be sent for special study and treatment. Probably the ideal plan would be for such centres to be organized by the Universities. It is quite contrary to our national ideas of independence for any compulsion to be used about the segregation of difficult fractures. But it would be an immense step in advance if every University or teaching hospital could provide one first-rate fracture treatment centre, both for the good of the community and for the advancement of knowledge. If this were done, the suitable cases would very quickly be sent there.

*The treatment of open infected fractures.*—In this subject we are at the disadvantage of having little or no assistance from experimental work, but on the other hand we have all the teaching of the war. It is a comparatively new subject, since it is only subsequent to the discovery of the nature and treatment of wound infection, that conservative as opposed to amputation treatment has been possible. While it is not desirable to attempt any critical review of the war work in relation to infected gunshot fractures, it is necessary to refer to the cardinal facts which emerge from this welter of blood and pus, because the rising generation will soon have forgotten those things which we only learned by bitter experience and disappointment. These cardinal facts may be grouped under three headings—namely, the time factor, immobilization, and wound disinfection.

*The time factor.*—Severely infected wounds can only be radically treated with any chance of success if efficient operative cleansing is undertaken within a few hours of the injury. Probably six hours and certainly not more than twelve hours represent the longest time which may elapse between the receipt of the injury and any chance of effective primary cleansing of the tissues. And this time factor will be modified according to the severity of the wound, the degree of infection and the efficiency of primary immobilization.

Thus a very short time can be allowed for a wound of a penetrating character with no natural drainage, for one heavily charged with dirt and foreign débris, especially if there is much comminution of the bone. And what is most important from a practical point of view, the urgency of the time factor is much greater if the limb is left unsupported and unfixed. On the other hand, if the wound is of an open superficial character, the infection slight and the limb securely fixed from the first, then a much longer time may elapse before the chance of primary sterilization of the wound is lost. These practical points taught by the war are to be applied to the infected fractures of civil life. The necessity of thorough wound toilette is a very urgent one and demands instant action just as much as a perforated gastric ulcer or intestinal obstruction. If the accident occurs in a remote place the efficient temporary immobilization is of vital importance for transport. To carry a man on a stretcher, when he has an infected shattered limb, which is allowed to roll about, ensures that the infective agent will be rubbed into the tissues at every jolt.

*Immobilization.*—The limb must be securely fixed from first to last. Before disinfection it must be fixed in order to prevent the dissemination of the infective agent; after disinfection it must be fixed to allow smooth healing both of bone and soft parts. Before wound treatment, splint fixation ought to be a very simple problem. It is merely to keep the limb from moving during transport. But even in this simple affair it is easy to go wrong. The only effective fixation is that which acts by maintaining traction on the wounded limb. In the very first act of handling the patient the limb should be pulled upon as it is lifted. It should then be placed in a Thomas' splint without removing the clothing. By some simple device fixed to the hand or the boot the limb is tied to the lower

end of the splint so as to keep all the tissues, muscles, vessels and bones in a firm tension which promotes comfort and prevents further injury. This general use of the Thomas' splint for severe arm or leg injuries ought to be taught to all Ambulance men, especially to those employed in connection with railway services. It is deplorable that in times of peace we should be taken quite unprepared in this respect by sudden railway or other industrial accidents. But this really happens with the same kind of results as occurred in the early days of the war. That is to say a railway accident occurs in a remote country district, perhaps twenty people have severe compound fractures, but these unfortunate people though quickly served with ambulance and train service often have no proper splinting applied to their limbs and by the time that they reach their destination in a city hospital, gangrene or virulent infection has occurred, which in some instances might have been prevented by the timely application of the Thomas' splint.

After the patient has been admitted to hospital the problem of the first urgency is the proper treatment and disinfection of the wound, but for the sake of simplicity I would prefer to continue the consideration of the subject of splinting, for even though the cleansing of the wound has to be done before the limb is finally put up, yet the plan for splint fixation has to be in readiness for application when the wound toilette is complete. For the early days of all bad cases some form of metal frame splint is almost essential. Of these there are many varieties, e.g. Thomas' splint used all over England and America, Braun's splint chiefly in Germany, Austria and Switzerland, and the cradle splint designed by the present writer. The actual variety of splint used is of less importance than that of familiarity with the special one employed and the rigid observance of the principle of efficient axial traction. For this, skeletal traction is by far the best

method because it is simple and efficient whilst it leaves the limb uncovered by any adhesive appliances so that the wound can be attended to without hindrance.

In a fracture of the humerus, the olecranon is transfixed whilst the arm is slung in a Thomas or Jones splint. In one of the femur, transfixion is done through the tubercle of the tibia and the limb laid upon a cradle splint with 30 to 40 lbs. traction, the hip and knee being flexed. In the leg fracture the transfixion should be through the os calcis and if to avoid perforating the bone the pin is put above the heel bone it should be incorporated in a plaster of Paris shoe at the time, so as to avoid the painful lateral movements of the pin in the soft parts. The leg bones usually require about 20 lbs. traction weight. The length of time during which skeletal traction should be kept up will vary according to the progress of the wound healing. But it is seldom necessary to keep it up longer than four weeks, because by that time a plaster cast can be applied even if the transfixion pin is left in place.

*Wound disinfection.*—This is the crucial point of the treatment, although as already mentioned the time factor and proper fixation must be taken into consideration as having most important effects upon recovery. Of all the many methods of wound disinfection tried in the war, the only one that has remained in universal esteem is that of mechanical cleansing. We went through stages of doing as little as possible—leaving things to Nature and using no antiseptics; of using all the old antiseptics, including carbolic acid and corrosive sublimate; of opening up the wound and packing it with salt; of irrigating wounds day and night by hypochlorites or Dakin's solution; of packing with new antiseptics, derived from the aniline dyes, e.g. flavine. But none of these really proved to be either necessary or reliable unless used as mere adjuncts to the thorough mechanical cleansing which

the French call *débridement*.

The infected broken limb should be regarded as if it was a part of the abdominal cavity into which there has been suddenly plunged a mass of dirt and debris. Immediate and thorough opening up of the tissues right down to the remotest part which has been injured, cutting away torn and soiled skin, muscle and fascia; removal of gross dirt, foreign bodies and of bits of bone which have been separated from their soft tissue connections—these are the essential steps in mechanical cleansing. In all these respects there is a definite parallelism with the treatment of an acute abdominal infection. In the limb, irrigation will be more useful and less dangerous than in the abdomen. In both the question of drainage must be considered before the wound is closed. Only ideal conditions justify primary suture of an infected wound. In doubtful conditions the wound should be packed lightly with a flavine pack and sutures placed but not tied. Then within 48 hours, if removal of the pack shows a clean healthy wound, the sutures are tied with perhaps one or two rubber strips between some of the stitches. This method of primary or delayed primary wound suture gave great success during the later stages of the war, and the fact that it is rarely successful in industrial accidents is due to the exceptional occurrence of the special type of the latter. Also, too often, delay and temporizing methods are used or the mechanical cleansing is not made with the same care, or by the same surgical team as would set to work over a perforated gastric ulcer. So that in actual practice of civil surgery, the common type of an infected fracture that we have to deal with is the sub-acute infection in which primary wound disinfection has failed. Until recent years there were only two kinds of treatment available for such a case and both were open to grave objections. In both these methods the broken bone was kept in correct length and alignment by means of some form of traction



which would allow of constant or frequent attention to the wound. The method in common use consists in daily changing of the dressing with the use of mechanical and chemical disinfectants, e.g. peroxide of hydrogen, eusol or flavine. The other method is that of leaving small tubes in the depths of the wound and irrigating the latter at frequent intervals with Dakin's solution. Each of these methods is slow and uncertain and makes great demands on the skill and care of the nursing staff, besides being wearisome and painful to the patient. Moreover there is great danger of the traction being disturbed by the daily dressings so that only too frequently, when union and healing do at length take place, there is overlapping and angulation of the bones.

It is exactly for this common type of tedious and difficult case that the treatment introduced and practised by Winnett Orr is invaluable. It will simplify matters if this method is first described as used in an ordinary case, before discussing the principles on which it is based.

Take, for example, the common type of infected fracture of the tibia and fibula in which there is some comminution of the shaft of the tibia about the middle of its length with a wound, which has failed to heal by primary union. The skin of the leg is thoroughly cleansed by shaving and disinfection with spirit or iodine. The patient is placed on a Hawley's table and the foot, after being transfixed with a pin through the os calcis, is fixed to the foot piece of the table and screw traction applied to the leg until it is as long or longer than its fellow. Actually the final traction can be made after the wound has been opened and the bones exposed. The edges of the wound are cut away and the opening enlarged so as to give a good exposure of the bones. All granulation tissue, ragged muscle or fascia are dissected away and loose fragments of bone removed. A part of the front of the main bone

fragments is chiselled away so that a conical cavity is produced, at the bottom of which is the deepest part of the affected bone. Bleeding is arrested by gauze pressure. When this has been done, the whole wound is packed with gauze, first soaked in tincture of iodine and then with spirit. Lastly, it is packed with gauze impregnated with sterile vaseline, so that the top of



FIG. 1.—Open infected fracture of the tibia and fibula, two months after injury, showing overlapping of the bone.

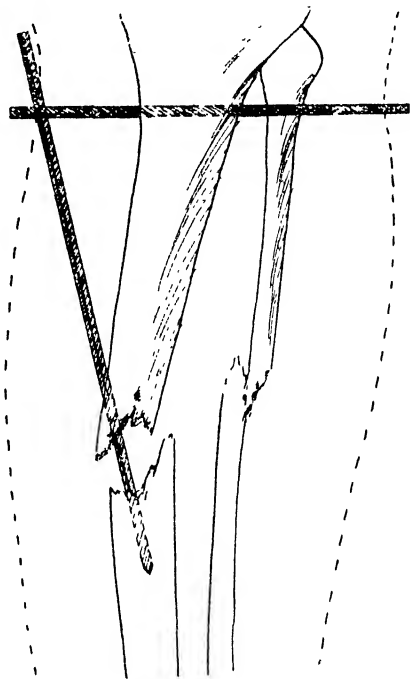


FIG. 2.—The same case after treatment by traction and transfixion. The tibia is transfixed above and the os calcis below. (Latter not shown.) A third transfixion pin goes through the broken ends of the tibia to correct lateral deviation.

the vaseline pack is level with the surface of the skin wound. No sutures of any kind are used, so that there is left a conical wound packed with vaseline. A vaseline gauze pad is placed over the wound and the whole limb is covered with gauze and wool.

In regard to the actual adjustment of the main fragments of the bone; if these by mere traction on the os calcis pin come into good position nothing

further need be done. But if lateral displacement still persists then this is corrected and good position maintained by a suitable transfixion pin going through both fragments and coming out through the front of the wound, which is then treated with iodine, spirit and vaseline, as described above. In order to maintain the bones in position if much traction has been necessary to adjust them it is best to place another



FIG. 3.—The same case six months later. Firm union, good alignment and full length.

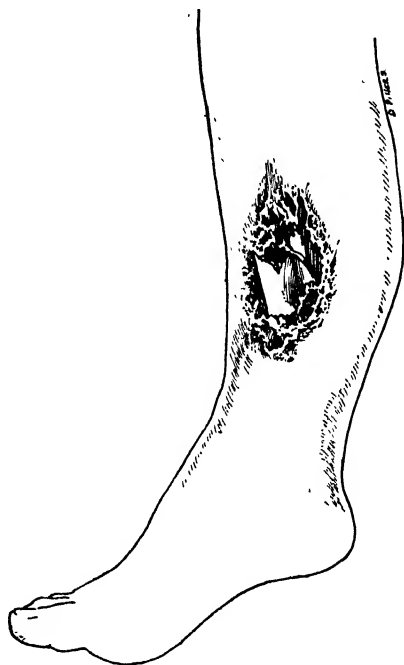


FIG. 4.—Appearance of the leg before treatment.

transfixion pin through the upper part of its tibial shaft. The whole leg is then cased in plaster of Paris from the lower third of the thigh to the balls of the toes, incorporating two or three transfixion pins. After the plaster has set, the patient is removed from the Hawley's table and put to bed with the leg slung in a cradle and a 10 lbs. weight attached to the foot over the plaster in order to steady the limb and to

lessen the tension on the pins. *No window is cut in the plaster and no further dressing of the wound is done for several weeks.*

In an ordinary case there may be some rise of temperature between 100° and 102° F. for the first two or three days after which the temperature settles to normal. In about ten days the transfixion pin is

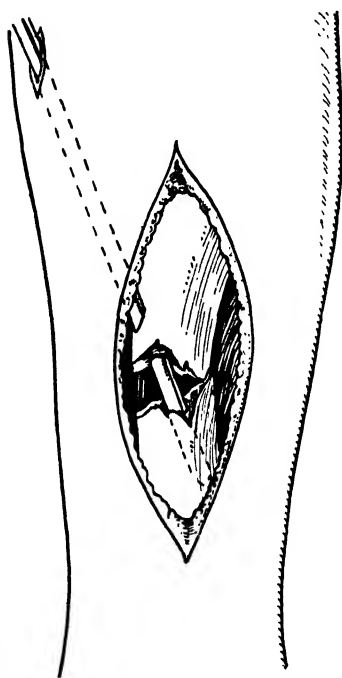


FIG. 5.—The tibia after removal of granulation tissue and the superficial parts of the bone, showing transfixion pins holding the fragments in alignment.

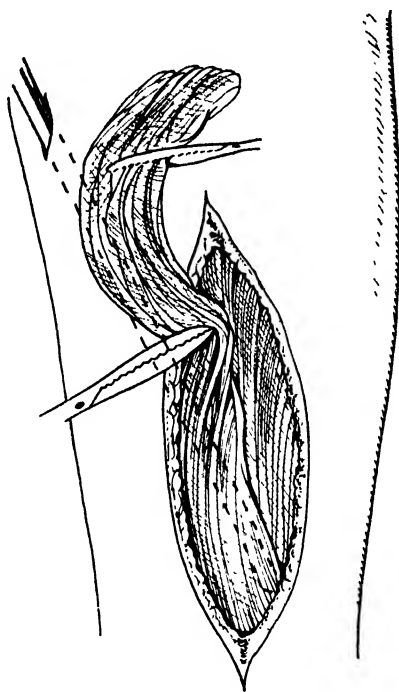


FIG. 6.—The wound left widely open and packed with vasoline gauze.

removed from the site of fracture and in four weeks the other two pins are taken out from the upper and lower parts of the limb.

A certain amount of oozing of blood occurs into the plaster directly after the operation and towards the end of the first week an unpleasant odour occurs, which remains until the plaster is removed. This is done in six to eight weeks after the operation and although an

anæsthetic is not necessary, it is advisable. It will be found then that under the plaster the wound has healed in a most remarkable manner, the whole conical cavity having filled with firm granulation tissue, which has pushed the vaseline pack to the surface. The whole limb is cleaned with spirit; a new vaseline pad laid over the granulating wound and plaster is reapplied. Probably there will be good bony union, and in this case the plaster is only put on over the leg from below the knee and the patient is allowed to get about with crutches.

I must admit that this treatment and the subsequent course of the case as I have described it sounds quite incredible, and frankly I did not believe it until I saw it for myself. But having once seen it and used it repeatedly I say without hesitation that it represents a very great advance in our methods of treating infected fractures.

At any rate let us admit for the sake of argument that this course of events does really follow the treatment in the majority of cases and consider what has been gained by it. In the first place there has been secured a good union of the bone with full length and perfect alignment. There is no question of being content with a fair bone position in order to secure wound healing. In the second place the treatment after the operation is greatly simplified and the rest, comfort and recovery of the patient assured, from the fact that he is freed from the daily pain and dread of dressing. The care and nursing of the patient is changed from being tedious and difficult to being so simple that the patient can be transferred to his own home or a subsidiary hospital. But of course this transference can only be made if reliance can be placed on the doctor or nurse not to interfere with the plaster case. It must be admitted that it requires robust faith on the part of the patient and his attendants to believe that all is well with a surgical case which smells

so vile.

The Winnett Orr method involves four principles : (1) Perfect fixation and immobilization ; (2) thorough mechanical and chemical disinfection ; (3) perfect drainage ; (4) avoidance of wound exposure after the initial operation. It is not necessary to stress the importance of the first two points, because no one will dispute it. But the crux of the matter is that perfect fixation and immobilization with sterilization of the wound can be assured by this method more certainly and more simply than by any other, because it allows adjustment and fixation through an open exposure and then permits this to remain without fear of disturbance until the bones have had time to unite.

It is the method of drainage and the closure in plaster which at first sight seem to shock our surgical instincts or tradition. From time immemorial it has been the rule or custom to dress a septic wound daily or several times a day—and yet a moment's reflection will serve to throw doubt on the soundness of this tradition. In the first place there is the admitted failure of the daily dressing to cause rapid healing in any but a very superficial wound. Then there is the undoubted fact that however carefully dressings are done, secondary infection will always occur in the wound sooner or later. This is best seen in the treatment of conditions of chronic bone suppuration whether tuberculous or staphylococcal. No one would think of opening a psoas abscess freely, packing it and then dressing it daily, because sad experience has shown that such a method would certainly lead to secondary infection which can never be eradicated. On the other hand if a chronic abscess be aspirated and otherwise left alone it will heal, provided that the primary bone focus causing the abscess be kept at rest.

The Winnett Orr method, by leaving the wound widely open and packing it with vaseline, makes it impossible for any discharge to be imprisoned in the

tissues. The firm and even pressure of the vaseline pack supported by the unyielding plaster must also have a definite influence in stimulating the healthy growth of the tissues of repair.

It is not claimed that this method is either of universal application or incapable of leading to failure. It is probable that occasionally the initial disinfection and drainage may be insufficient and within a few days of the operation a raised temperature, increased pain and general malaise will point to the necessity of cutting open the plaster. In some cases it is probable that non-union will occur, but this is much less likely than with any other method of treatment, and if it follows the Orr treatment I believe it would have resulted in any case. The method is a comparatively new one and it is certainly capable of modification and improvement. Some method of ventilation and deodorization will make it much more pleasant and popular.

# The Radiology of Bone Injuries

By H. K. GRAHAM HODGSON, C.V.O., M.B., B.S., D.M.R.E.  
*Honorary Radiologist to King's College Hospital, and to the Central  
London Throat, Nose and Ear Hospital.*

**I**N all cases of suspected fracture an X-ray examination is advisable and in most instances essential. Not only is such an examination carried out in order to determine the presence or absence of a fracture in doubtful cases, but information with regard to the position of the fragments, comminution, and any pathological condition of the surrounding bone, is gained thereby. The fragments may require to be set under an X-ray screen, in order to obtain the best possible apposition, and at a later stage the degree of union can be estimated by a further examination.

The majority of cottage hospitals are now equipped with X-ray installations, but since many of them are remote from large towns and the services of a radiologist, the responsibility for taking and interpreting the radiograms often devolves on a general practitioner, who has no specialized knowledge of the subject; for though the recognition of a gross fracture or dislocation is a simple matter, there are many pitfalls besetting the feet of the inexperienced and unwary in this branch of medicine, and I will therefore confine myself to the radiographic appearances of those injuries which may escape recognition, and to normal appearances which may be interpreted as abnormal by the beginner.

The first essential in the interpretation of radiograms of bone injury is a very accurate knowledge of the normal, and also of bone pathology and the processes of repair. Stereoscopic radiograms in most instances are necessary, and in every case it is essential where



possible to take views in both antero-posterior and lateral positions. Not infrequently—and especially where the joints of children are concerned—it is advisable to take the joints of the opposite side for comparison.

There should be no haphazard positioning of the bone or joint, but there should be a definite standard position for each with a standard centering point, and these positions and centering points—which are described in detail in any textbook on radiography—should be rigidly adhered to. Standardization of technique is the key-note of good radiography. Additional views may sometimes be necessary in order to show up some particular point, but the standard views should never be omitted.

#### THE SKULL

To those who are not accustomed to studying radiograms of the skull, the multiplicity of the shadows thrown by the component parts present great difficulties. Numerous vascular markings and fissures are present, all of which may be wrongly diagnosed as fractures. Fissures show an even, serrated line of equal width throughout their entire length, appearances which are never seen in fractures. Vascular markings are a more common cause of error. Linear fractures of the vault appear as sharp, black lines with irregular edges, and may run in any direction, while vascular markings have a definite course, are bilateral, have a smooth margin, and are lighter in colour. Diploic veins cast an ill-defined, dark shadow, and may be linear or stellate. Stellate fractures, on the other hand, are usually fairly obvious, clear-cut, and cast a lighter irregular shadow. Depressed fractures are shown as dense, white lines, because of the overlapping of the edges of the fracture. Fractures of the base are often difficult to detect. Radiograms in several positions are essential, and must be of the best possible quality.

Fig. 1 shows a fracture through the petrous bone. Facial bone fractures are common concomitants of motor accidents, and may be easily missed unless the mechanism of such fractures is thoroughly understood. The nasal bones are most commonly injured, and such injuries are best shown by soft lateral views. Fractures of the body of the malar bone are uncommon. Fractures of the orbital or zygomatic processes of the malar bone frequently occur, but are often missed because the only view taken is that shown in Fig. 2. This shows an opaque left antrum, with no apparent fracture. Closer inspection, however, reveals a widening of the synchondrosis between the frontal process of the malar bone and the malar process of the frontal bone, which is always an indication of fracture in one of the other processes of the malar bone. A further view taken in the position shown in Fig. 3 of the same case shows that there is a fracture of the lower orbital margin in the neighbourhood of the infra-orbital foramen, the orbital process of the malar bone being depressed backwards into the antrum, a lesion entirely concealed in Fig. 2. It is of great importance for treatment that such fractures should be detected before much callus has been formed, so that reduction of the fracture can be effected by Gillies' operation.

Fractures of the mandible are usually clinically obvious, but should be radiographed to show the position of the fragments with the relationship to neighbouring teeth, for the purpose of immobilizing the fragments by means of dental splints. Such a fracture is seen in Fig. 4.

#### THE VERTEBRÆ

Dislocation of the cervical vertebræ is rarely seen by the radiologist. Where such a possibility is present a lateral view is usually the best perspective (Fig. 5). Lateral views of the cervical vertebræ are best taken in the erect position where possible, the shoulders

pulled downwards and forwards, otherwise the seventh cervical vertebra may be missed. In the erect position with the shoulders pulled downwards and forwards, not only the seventh cervical vertebra, but the upper dorsal vertebra can also be shown on the same radiograms. A condition seen more rarely is dislocation of the dorsal vertebra (Fig. 6).

Fig. 7.—Crush fractures of the body usually occur in the dorsal or lumbar regions, as the result of severe injury. Fracture lines are rarely seen, but the abnormality in outline of the body and consequent angulation of the spine in its neighbourhood is the most common appearance. This may be concealed in the antero-posterior view, and a lateral view should always be made. A further distinguishing point about crush fractures of the spine is that in the antero-posterior view in such injuries one commonly sees a spreading of the body. Callus formation is usually very slight in such cases, and fractures of the lumbar vertebræ are frequently associated with fractures of the transverse processes, as in this case.

Fig. 8.—Congenital non-union of a transverse process is commonly seen, usually in the first lumbar vertebra. It may or may not be bilateral, but can be distinguished from a fracture by the absence of displacement and the regularity and normal density of the approximating edges. Another possible cause of error is where the approximating edge of the psoas and the inner border of the kidney produce a linear shadow of increased density across a transverse process, simulating fracture. Closer inspection, however, will reveal that the linear shadow extends beyond the limits of the process.

Congenital abnormalities of the fifth lumbar vertebra are so numerous that many papers have been written solely on this subject. The lateral articulation between it and the sacrum may, on one side, be in the antero-posterior plane, and therefore obvious as an articula-



FIG. 1.—Fracture of the right petrous bone.



FIG. 2.—Shows an opaque left antrum and also widening of the left fronto-malar suture. Closer inspection shows a fracture of the tubercle of the left zygoma.



FIG. 3.—Same case as Fig. 2: shows fracture and backward depression of the left lower orbital margin, invisible in the other view.



FIG. 4.—Fractured mandible.



FIG. 5.—Dislocated cervical spine.



FIG. 6.—Dislocated dorsal spine.

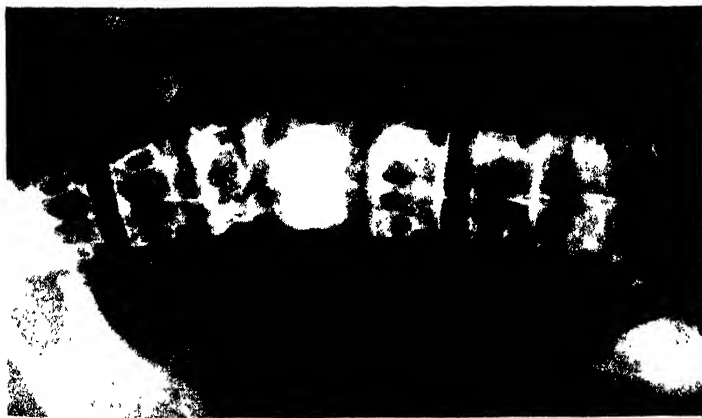


FIG. 7.—Crush fracture of 1st lumbar vertebra (taken by portable apparatus).



FIG. 8.—Congenital non-union of transverse processes of 1st lumbar vertebra.



FIG. 9.—Sacrolisation of 5th lumbar vertebra.



F . 10.—Dislocation of acromio-clavicular joint.



FIG 11.—Calcification in tendon of supraspinatus, sometimes mistaken for a fracture.



FIG. 12.—Spontaneous fracture through fibrocystic disease.



FIG. 13.—Myositis ossificans in brachialis anticus.

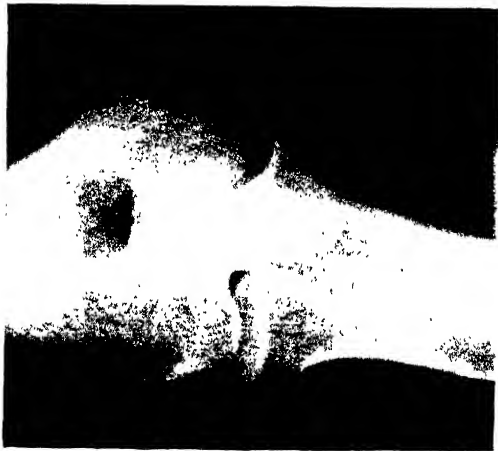


FIG. 14.—Fissure fracture of the head of the radius.



FIG. 15.—Dislocated semilunar.





FIG. 16.—Fractured scaphoid.



FIG. 17.—Fracture of descending ramus of right pubic bone.



FIG. 18.—Fracture through femoral neck, showing how easily such a fracture may be missed, unless the negative is closely examined.

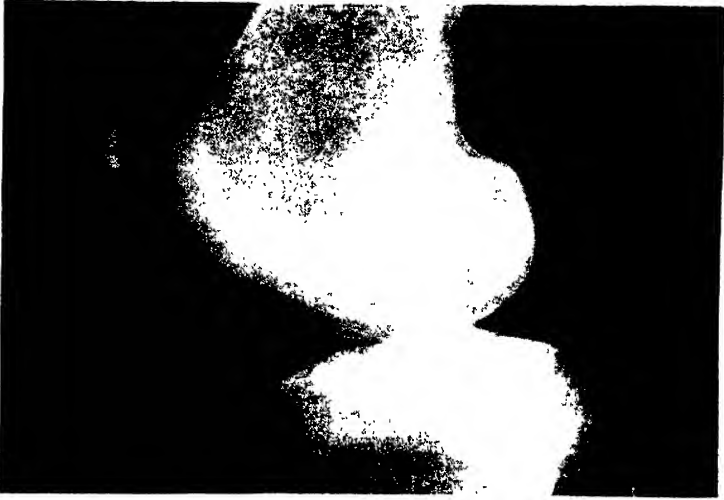


FIG. 19. Sesamoid in outer head of gastrocnemius



FIG. 20.—Oblique fracture of tibia with fracture of upper end of fibula.



FIG. 21.—Os trigonum.



FIG. 22.—Sesamoid bone developed in two halves.



FIG. 23.—Fractured os calcis.

tion, while on the other side it may be situated obliquely so that the articulation cannot be seen. This must not be interpreted as being pathological. Incomplete fusion of the laminae, both of the fifth lumbar vertebra and of the sacrum, is common. The transverse processes of the fifth lumbar vertebra may vary widely in breadth, sometimes being so wide as to form a false joint with the upper border of the sacrum, and not infrequently being seen actually to fuse with the sacrum, this condition being known as sacrolization of the fifth lumbar vertebra (Fig. 9) shows the condition affecting the left side of the vertebra. The frequency and possibility of such abnormalities should be borne in mind when studying the radiograms in a case of a possible injury of the lower lumbar spine.

#### THE THORAX

Fractures of the ribs may pass unrecognized radiologically if a single radiogram in the antero-posterior projection only is taken. A fracture may be in such a position as to be tangential to the path of the rays, or it may be superimposed on the liver or heart shadow, and therefore concealed by the relative opacity of these underlying structures. In the first place, therefore, oblique as well as antero-posterior views must be taken, and in addition, where the site of injury lies over the liver or the heart, a greater degree of penetration than that used for ribs covering the lungs is necessary. The rib cartilages are non-opaque to X-rays, but they undergo progressive calcification after about forty years of age. Areas of calcification in the rib cartilages must, therefore, not be interpreted as due to injury. When looking for healed rib fractures with callus formation, it should be borne in mind that a strip of thinner bone shadow six to ten centimetres in length, running along the lower margin of the posterior halves of the ribs, is not due to callus or periostitis, but is a normal shadow caused by the

sharp overhanging margins of the intercostal groove. Owing to the superimposition of the heart and spinal shadows the sternum cannot be seen in the postero-anterior view, but must be radiographed in the oblique projection to throw it clear of these shadows. A lateral view also is often useful.

#### THE UPPER LIMB

Tearing of the capsular ligament with dislocation of the acromio-clavicular joint is a not uncommon accident (Fig. 10). The displacement of the outer end of the clavicle is upward. Abnormal areas of calcification round the shoulder joint are sometimes mistaken for fractures. Fig. 11 is a case in point, showing a deposition of calcium stearate in the tendon of the supraspinatus. A further condition of this type is calcification in the subdeltoid bursa. This condition may not be visible in the usual antero-posterior view, but in suspected cases inward rotation of the arm will bring the calcified area into view. These conditions are usually symptomless, until an injury to the shoulder produces pain, generating suspicion of a fracture with consequent increased tendency to misinterpretation. The absence of any irregularity of the adjacent surface of the humerus, and of bone striation in the calcified area, should enable a correct diagnosis to be made.

In all cases of fracture the condition of the surrounding bone should be carefully examined for disease affecting the bone, such as cysts, new growth, and especially so in cases in which fracture has occurred with an apparently small amount of trauma. Fig. 12 shows a fracture through fibrocystic disease in the upper end of the humerus.

When X-raying the joints of young people following an injury, particular attention should be paid to the position of the epiphyses. In cases of doubt as to the normal position, a simple check is to radiograph the opposite joint, but the radiogram must, to be comparable, be taken in exactly the same position. Myositis

ossificans occasionally follows trauma. The commonest sites are the brachialis anticus and the quadriceps. Fig. 13 illustrates such a condition in the arm. Note the typical clear zone, between the calcified area and the shaft of the humerus. This clear zone disappears later, the new bone, diminished in size, appears as a projection from the shaft, the so-called "bone scar."

There are several pitfalls in the radiology of the elbow joint. Two or even more centres of ossification of the olecranon process are sometimes present. In the majority of cases this abnormality is bilateral, and in addition, the edges of the osseous centres do not show the irregular appearance of a fracture. With regard to the epiphysis for the radial head of the humerus, one should have a very exact knowledge of the normal appearance, as otherwise one is apt to diagnose a separation when no such separation exists.

Fissure fractures of the head of the radius may be missed unless carefully looked for (Fig. 14).

The commonest injury to the lower end of the radius and ulna is a Colles' fracture. Stereoscopic antero-posterior and lateral views should be taken, and the lateral view must be exactly lateral, as a very important point is to determine the degree of backward tilting of the radial fragment. In the carpus, dislocation of the semilunar, and fracture of the scaphoid are the commonest injuries. Both conditions may sometimes not be obvious to one who has no accurate knowledge of the radiological normal (Fig. 15 and Fig. 16).

Carpal bones are best seen in the postero-anterior view, if taken with the hand in full ulnar deviation. As in the foot, accessory ossicles and sesamoid bones are frequently met with in the hand, and must not be mistaken for fragments of bone separated by fracture.

It is not necessary, in such an article as this, to enumerate all the accessory ossicles which may be

found in the hand, but their possible presence should be borne in mind when a small, apparently loose piece of bone is seen in the wrist or hand. They can be distinguished by the fact that they are smooth in outline, the bone striations are normal, and there is no irregularity of the bone near which they are lying, and they are usually bilateral. Sesamoid bones are very commonly met with in the flexor tendons of the fingers.

In radiographing the phalanges and metacarpals for possible fracture, the true lateral position throws the shadows of the bones over one another. A useful additional position is that taken in the semi-pronated position, which gives a complete view of the hand, and throws the metacarpal bones and the phalanges clear of one another.

#### THE LOWER LIMB

When radiographing the pelvis, care must be taken to see that it is absolutely level, and that there is no tilting. In young people, a strip of bone is seen above either ilium, separated from it by a clear area about four millimetres in width. This is the normal epiphysis of the iliac crest, appearing in the fifteenth year and uniting in the twenty-second. One frequently sees in radiograms of the pelvis several small, rounded opacities on either side of the pelvic cavity. These are phleboliths, and are of no pathological importance. Fractures of the pubic bone usually show only slight displacement, and consequently may be overlooked in the radiograms if not good (Fig. 17).

A small, rounded shadow is occasionally seen to the outer side of the upper end of the acetabulum. It is frequently bilateral, but is occasionally unilateral, as in the case illustrated in Fig. 9, and is due to an uncommon accessory ossicle, and is of no pathological importance. Its smooth, rounded outline, and the absence of any irregularity of the approximating edge of the acetabulum, distinguish it from fracture.

When radiographing the hip joints, both hip joints should be taken on one film for comparative purposes, and then a further radiogram centred over the hip joint in question.

Impacted fractures of the femoral neck may sometimes be difficult to detect, especially when the line of fracture is close to the distal end of the neck (Fig. 18). In cases of doubt inward rotation of the leg will bring a greater length of the neck into view.

The patella is poorly seen in the antero-posterior position, better in the postero-anterior view, but best of all in the lateral or vertical projection. The latter is obtained by placing the patient on his face, the film being underneath the patella, the knee being then flexed as much as possible, and the tube inclined so that the central ray passes through the long axis of the bone. Transverse fractures are always easily seen with good radiograms, but linear fractures, and fractures above the insertion of the quadriceps, where there is little or no separation of the fragments, are more liable to escape notice. Oblique views of the patella are often useful in such cases. A rare abnormality is the presence of more than one centre of ossification of the patella, with a consequent bi- or tri-partite bone. Such a condition must not be confused with fracture. It is usually bilateral, the edges are smooth and regular, and if a further check is needed, no callus, of course, will be found a few weeks later. Very frequently an oval opacity will be seen in a lateral radiogram of a knee-joint posterior to the joint, as in Fig. 19. This is not a loose fragment of bone, but is a very common sesamoid in the outer head of the gastrocnemius muscle.

An oblique fracture of the lower third of the tibia is not infrequently accompanied by a fracture in the upper end of the fibula, and if a radiogram only includes the lower end of these bones and the ankle-joint, the fracture of the fibula may be overlooked. If, however, there is any appreciable degree of overlap in the tibial



fragment, it should be obvious that the fibula must also be fractured to conform with the shortening of the leg, and a further radiogram should be taken to show the site of the fracture in the fibula (Fig. 20). An uncommon abnormality is the presence of an accessory ossicle immediately posterior to the posterior process of the astragalus, and known as the os trigonum (Fig. 21). This has frequently been mistaken for a fracture, but its significance is easily established by radiographing the opposite foot, as it is almost invariably bilateral. As in the hand, there are many accessory ossicles occasionally seen in the foot, and sesamoid bones in the flexor tendons are extremely common. They can be distinguished by the same method as described in the radiography of the hand, and they should never be confused with possible fracture.

Sesamoid bones are sometimes developed in two halves, particularly the inner sesamoid bone in the flexor brevis tendon of the great toe (Fig. 22), and one should therefore be very cautious about diagnosing a sesamoid bone fracture, although such a fracture is a rare occurrence. The fractures show sharp edges or points, while congenital bifid bones show rounded edges. Fractures occur occasionally without any apparent trauma in the second or third metatarsal bones. The condition usually occurs in flat-footed people without any obvious trauma, and is accompanied by considerable pain. It is often a sequel to excessive marching, or violent exercise, and is termed "marching fracture." Fractures of the os calcis (Fig. 23) are usually caused by heavy falls on the feet.

These, then, are the possible causes of error most commonly met with in the radiology of the skeleton, in cases of presumed fracture. The radiologist should be told the clinical facts of the case, to lead to his co-operation, and to enable him to take radiograms of the part at the angle best suited to show the suspected lesion.

With regard to the processes of repair in bone injuries, it should always be borne in mind that the only two processes which are capable of being revealed radiographically in bones are bone destruction and bone production. Consequently, there may be fibrous union of a fracture, but no X-ray evidence of union until bony callus has been deposited. This does not, as a rule, take place until three weeks after the injury, and the deposition of bony callus may be delayed very much longer in old people, and also in pregnant women.

Where displacement of the fragments is slight, only a very slight amount of callus will be laid down. Where there is marked displacement of the fragments, the amount of callus will be proportionately large. It is not infrequently dangerous on purely radiographic evidence to diagnose ankylosis. Following arthrodesis of a knee-joint, for instance, a radiogram may show apparently solid bone a week or so later, extending from the femur into the tibia. This is merely due to the exact apposition of the ends of the bones, with apparent continuation of the striæ from one bone into the other. Again, it should be borne in mind in cases of possible early bone infection that the Haversian canals may be filled with pus, but yet there may be no radiological evidence at the time the X-ray is taken of osteomyelitis. This, of course, is due to the fact that though pus is present, there is at the time the radiogram is taken no actual destruction of bone, and it is only this destruction of bone which is visible on the radiogram. Such instances as this should impress on those responsible for the taking and interpretation of radiograms that the clinical evidence is pre-eminent, and should always be borne in mind, and that though radiography has revolutionized the diagnosis and treatment of fractures, it was never meant to, and never will take the place of the surgeon's ten fingers.

# General Anæsthetics in Fractures and Accidents

By C. W. MORRIS, O.B.E., M.B., B.S.

*Senior Anæsthetist to University College Hospital ; Anæsthetist to the Royal Free Hospital.*

IN considering the question of a general anæsthetic for fractures and accidents, the cases can be divided into two categories according to the condition of the patient: first, those requiring immediate operation, and secondly, those whose condition permits of surgical aid being given at leisure, and after full preparation and examinations have been carried out. It is apparent that in the first class of case the patient's condition will probably be worse than in the second, loss of blood and shock may be present in varying degrees, and the treatment of these conditions may call for more attention than the actual induction of anæsthesia. In fact, these cases resemble those met with in the war, and the general conclusions arrived at then are applicable here. Warmth and the replacing of the loss of blood are the first requirements of the patient. Gas and oxygen with a minimum of ether is generally considered to be the anæsthetic of choice, while spinal analgesia is held to be undesirable in shocked patients, on account of its liability to lower the already low blood pressure.

The choice of the anæsthetic will rest with the administrator, who will naturally incline to the method and agent with which he is most familiar. In the absence of facilities for giving gas and oxygen the older established methods of open ether, or chloroform, or a mixture, will give the anæsthesia required. If chloroform is selected, it appears that its safety is considerably enhanced by giving a small continuous

stream of oxygen with it, even when the colour of the patient is satisfactory without it. Chloroform so given is a very valuable anæsthetic. Old patients take it extremely well and with a very small amount it is possible to keep their breathing quiet and even and obtain an excellent relaxation. With open ether also a stream of oxygen assists the administration and has the advantage of diminishing the unpleasant after-effects. Perhaps there is a tendency at the present time to ignore the older methods and to forget the good results that can be obtained by their judicious use.

As an emergency method of resuscitation in loss of blood, the intravenous infusion of normal saline at body temperature should be kept in mind. Although this procedure does not possess the great advantages offered by blood transfusion and is in no way suggested as a substitute for it, it has the one great virtue of simplicity and can be carried out by a practitioner at a moment's notice, the only apparatus necessary being a hollow needle, a funnel and a piece of rubber tubing. Whilst the time taken in finding a suitable donor and making the tests and preparation necessary for a blood transfusion might cost the patient his life, the simple and rapid running into a vein of a couple of pints of warm saline might easily turn the scale in the patient's favour.

In considering the second class of patients who can be dealt with at leisure, it is obvious that the whole range of anæsthetics is open to the choice of the administrator, who again will be guided by his own personal predilections in the selection of the agent and method by which to give it.

#### RECENT TENDENCIES IN ANÆSTHETICS

Perhaps some reference here would not be out of place to the general state of anæsthetics, and the recent advances and tendencies noticed in this branch of medicine at the present time. The trend of all, or

nearly all of the changes that are so rapidly following one another centres round the increasing use of nitrous oxide gas. It is the limitations as well as the advantages of gas that have to such a large extent modified recent technique and led to the introduction of fresh methods. The idea of relying upon several agents rather than upon one agent for anæsthesia appears to be gaining ground. Although this has long been applied in a modified degree it is only comparatively recently that the American system of employing several agents, each contributing its quota towards the common object, has been extensively employed.

This tendency has been a gradual one and can be traced back to the time when mixtures were first introduced and gas used to aid the induction of ether in Clover's apparatus, and morphia given as a simple premedication. So highly do some surgeons appraise the value of distributing the burden of the anæsthesia between several agents that in cases of toxic goitre, for example, it is the routine for the patient to be given morphia gr.  $\frac{1}{6}$  or gr.  $\frac{1}{4}$ , hyoscine gr.  $\frac{1}{100}$  an hour before the operation, followed by paraldehyde  $\mathfrak{z}$ iv per rectum, then a local infiltration with 1 per cent. novocain and gas and oxygen at the time of the operation. On the other hand, there are some surgeons who prefer less complex methods.

The advantages of gas over chloroform and ether are well known and generally admitted, but it has certain disadvantages, and it is to counter these disadvantages that so many of the recent innovations owe their origin. The fundamental difficulty of using nitrous oxide for prolonged anæsthesia has been overcome by combining oxygen with it, and controlling and adjusting the mixture of these two gases by either a sight feed, or some mechanical adaptor which delivers a definite and known quantity of the gases. It is on account of the difficulty of getting sufficient relaxation and a deep enough anæsthesia with gas and oxygen

alone that has led to the use of combining with it the action of several drugs, and more lately still to the employment of intensive pre-anæsthetic medication.

The ideal of many anæsthetists of the present day is to cut down the use of chloroform and ether to a minimum and thereby avoid any toxic action which might arise from their use, and to rely as much as possible upon gas and oxygen. This ideal has been successfully attained in a large class of operations where slight relaxation is required, but in those operations where profound relaxation is essential, recourse had still to be made to chloroform or ether, so much so in fact, that the gas and oxygen played only a small part in producing the desired result. With the addition of spinal analgesia or local analgesia in suitable cases gas and oxygen could produce the required relaxation.

It is by pre-medication with one or another of a large variety of drugs, or basal anæsthetics, as they are sometimes called, that further assistance has been obtained in cutting down the ether or chloroform in many cases to vanishing point. Of the drugs given per rectum may be mentioned paraldehyde and avertin, which produce a state of sleep before the operation occasionally sufficiently deep to allow of minor surgical proceedings to be carried out without further anæsthetics, but in any case helping to avoid the use of much ether or chloroform with the gas and oxygen. The more recent introduction of derivatives of the barbituric acid group, sodium amytal, embutal, pernocton and nembutal, given either by the mouth, per rectum or intravenously, has given most striking examples of what basal anæsthetics can accomplish in correct doses and in suitable subjects and has led, to results which leave little to be desired. At present, however, there is not sufficient agreement as to the best method of administration, or of the dose of these drugs, to be able to make definite statements as to their use, but it appears likely that in time they will take

their place and prove a valuable ally to the anæsthetist.

There is no doubt in my mind that all basal anæsthetics are accompanied by some risks, and at present no unanimity of opinion exists as to the best and most trustworthy of the many agents at our disposal. All appear capable of giving good results, and all require special care and experience in their administration, and also in the nursing and after-treatment of the patients. Unquestionably a great advance in general anæsthesia will be made when a basal anæsthetic, safe, pleasant to take, free from deleterious after-effects, is discovered, and it seems likely that with the many drugs now being used that this ideal is well on its way to achievement. Then the dread of the anæsthetic and the unpleasant period of waiting for the zero hour of the operation to arrive, and the first few hours following the operation will be largely obliterated.

Those who have not the opportunity or facilities, or who do not care to use the more recently introduced basal anæsthetics, may do much to make pleasanter the administration of ether or chloroform. When using open ether the induction can be made so much more comfortable for the patient if it is induced by gas first. This can easily be effected with the ordinary gas-bag and face-piece. The patient is got under with the gas till stertor is heard when the gas-bag is rapidly put aside and the open ether mask, soaked in ether, substituted. With a little practice this method can be made to work smoothly, the patient has no knowledge of the change-over, is quickly unconscious, and is spared the penetrating smell of the ether and the choking sensations which are often present when ether alone is used from the first.

Again, if no gas is available and unquestionably it is a heavy and cumbersome apparatus always to carry with one, a tube of ethyl chloride, preferably a brand which combines eau-de-Cologne with it, will serve as

a useful substitute. In this case some 6-10 c.cm. sprayed on the inner surface of the mask for an adult, less for a child, is used for the first few breaths, and then ether is gradually dropped on in the ordinary way. This method is very helpful in cases where the patient is frightened by a bag or face-piece, and objects to anything being pressed down over the face. For children, whether nervous or not, this form of induction is most satisfactory. In difficult subjects the induction may be greatly assisted by giving carbon dioxide. A small stream of this gas is run in under the mask during the second stage of induction, and by its action on the respiratory centre stimulates the rate and depth of breathing and abolishes the tendency to respiratory spasms and holding the breath. The rate of absorption of the anæsthetic is thus greatly increased, and the second stage of induction very considerably curtailed. If after the operation it be desired to bring the patient "out" quickly, a stream of carbon dioxide given preferably with oxygen, hastens the elimination of anæsthetic and return to consciousness.

To obtain some share of the benefits claimed for the basal anæsthetics there is no doubt that the pre-medication with morphia gr.  $\frac{1}{8}$  to gr.  $\frac{1}{4}$ , or omnopon gr.  $\frac{1}{3}$ , combined with hyoscine gr.  $\frac{1}{100}$  given three-quarters of an hour before the operation yields extremely satisfactory results. To gain the best results from this procedure the greatest care must be taken that the patient is left absolutely undisturbed after the hypodermic injection has been made, the room darkened, the ears blocked with wool and every encouragement given to suggest sleep. It is as well, when possible, for the anæsthetist quietly to enter the room some minutes before the time fixed for the operation to see whether it is necessary to give a further  $\frac{1}{8}$  gr. of morphia. The induction should of course be made while the patient is in bed or on the trolley; in the latter case the patient should be placed



on the trolley before giving the injection. Unfortunately this technique is too often completely ruined by well-meaning friends coming in to have a cheery last word with the patients, or by nurses changing the patients' clothes or even expecting them to walk to the theatre.

Carried out properly with the co-operation of the nursing staff this simple method will often give most excellent results, the patient will tell you afterwards that he has no recollection of any event after the injection, and will sleep for several hours following the operation. It will be necessary to have the most careful supervision kept on the patient afterwards to see that no obstruction occurs to the respiration, and it is as well only to employ this premedication when complete trust can be placed in those who are in charge afterwards.

Turning to new methods of technique which have recently been suggested, that described by I. W. Magill<sup>1</sup> has proved of great value. It consists of the passage of a wide bore soft rubber tube through the nostril directly into the larynx. For operations upon the mouth, face, neck and the head this procedure has greatly assisted the anæsthetist. It claims advantages over the intratracheal as usually employed, in that the tube is simple to pass, and in the majority of cases this can be done without the aid of a laryngoscope. The wide bore provides for too and fro breathing and so does away with the necessity of keeping the airway free for the expirations, and thus allows the larynx to be packed off in cases where blood is likely to run down.

If the instructions are carried out one is surprised how often the curved rubber tube enters the larynx, and at the ease with which it does so. By keeping one's ear near the top of the tube it is apparent when the larynx is approached by the intensity of the breath sounds. Then gently pushing down the tube

during an inspiration its entry between the cords can clearly be detected, if the patient is light, by a characteristic cough, and also by the volume of air entering and leaving the tube. If the tube does not readily enter the larynx slight withdrawing and rotation and then pushing down again during an inspiration will enable one to "feel" one's way into the glottis, or if that fails, slightly flexing the head may allow the tube to take the desired course.

There still remain, however, a certain number of cases in which the tube steadily refuses to enter the larynx by this method and recourse must then be had to the laryngoscope, and the tube inserted under direct vision. Once the tube is in the larynx a perfect control over the patient's air-way is assured, and by means of one or other of the valved adaptors fitting to the top of the nasal tube, the anæsthetic can be continued by gas and oxygen with or without ether, or by bubbling oxygen through either ether or chloroform.

In many cases of fracture the convalescence will be long, and the splinting or placing in plaster of limbs necessitate a lengthy period in bed. This enforced immobility may predispose towards chest complications, especially in elderly and bronchitic subjects, and may easily render the prognosis grave in an otherwise hopeful case. This complication must be kept in mind and everything done to guard against it. Administration of atropine before the operation, the adjustment of the position of the patient afterwards, early attention to any cough may all help to obtain this object.

Gas and oxygen is generally considered to be followed by less chest trouble than any other inhalation anæsthetic—a further reason why this agent should be used whenever possible. Certainly prolonged soaking with ether is undesirable.

#### Reference.

- <sup>1</sup> Magill, I. W.; *Brit. Med. Journ.*, 1930, ii, 817.

# Injuries and Fractures of the Skull

By L. R. BROSTER, O.B.E., D.M., M.Ch., F.R.C.S.

*Assistant Surgeon, Charing Cross Hospital; Consulting Surgeon to the Bute Hospital, Luton, and Chesham Cottage Hospital; Examiner in Clinical Surgery to the University of Oxford.*

**A**LTHOUGH motor accidents during 1930 show a slight decrease on previous years, there has been a slight increase in the resultant fatalities. In 156,793 accidents there was a death-rate of 7,305, and injury to 177,895 persons. This increased mortality is probably accounted for by the average increase in speed. Among these road casualties head injuries must hold a high ratio of incidence. The number of "head-on" collisions must be considerable. Any sudden arrest of momentum, with an individual in the sitting posture, demands that the head, from its weight and lack of rigid support, must be thrown forward, and is most likely to be injured under such circumstances. Unfortunately, this habit of speed is often translated into the sphere of too rapid official disposal of the victims, without any attempt being made to consult local practitioners, especially in the severe cases. An ambulance is given the impetus of the fire engine when it requires the repose of a carriage and pair. In cases of bad shock, it is better to be left and tended near the scene of accident for several hours, and observation of the arrival of such cases show that their condition is improved in direct proportion to the length of time taken by the ambulance to reach hospital.

## HEAD INJURIES

There is probably no subject in which the diagnosis and treatment are more dependent on the accurate interpretation of the pathology and knowledge of the

various clinical types, nor one in which the anxieties and responsibilities of the practitioner are more severely taxed. The lay mind has, so far, not sufficiently realized the unpleasant sequels which may follow in the train of these accidents, even the most trivial. These should always be explained to the relatives or friends, in view of the compensation and litigation which invariably follow. The public is apt to focus its attention on the actual fracture, rather than the more important consequences to which it gives rise.

*Physical conditions.*—There are several peculiarities in the anatomical arrangement of the head which it is necessary to consider as an introduction to the subject, and no article can be complete in this respect without reference to Trotter's work.

The brain is surrounded by an inextensible capsule, the dura mater, and is contained within a rigid box, the skull. It lies in a natural bed of cerebro-spinal fluid, which bathes both its internal and outer surfaces. This fluid, secreted by choroid flexuses of the lateral ventricles, passes down the narrow channels through the third and fourth ventricles, and, escaping at the base of the brain in the region of the fourth ventricle, it spreads out over the surface of the hemispheres to be absorbed into the large venous sinuses through the Pacchionian bodies. Some of this fluid also passes down through the foramen magnum to bathe the spinal cord and nerve roots. The pressure of the cerebro-spinal fluid is low and runs *pari passu* with the pressure within the larger venous sinuses. The brain itself must be regarded as a sponge permeated by three zones of pressure. A zone of high pressure imparted by the narrow arterial inlet with a pressure corresponding to that of the systolic pressure within these vessels. This pressure gradually falls as the arterial channels divide and widen out to form the capillaries, and finally reaches a low ebb as the blood

passes into the larger veins and into the capacious outlet of the venous sinuses. As the brain cannot expand, any encroachment on the intracranial space is strictly limited to the displacement of a small amount of cerebro-spinal fluid down into the cord and a small amount of blood from the veins into the sinuses. Any increment to this encroachment will cause profound disturbances to the intracranial circulation.

The forces concerned with the production of a head injury are twofold : (a) the external violence applied to the skull which is momentary, and (b) the effect of such violence on the intracranial contents. The first effect of violence is to cause deformity, i.e. the skull is flattened out and will bulge at right angles to the point of application of the force; when its limit of resilience is reached, it will crack, usually in the form of fissures running down to the base in a parallel direction to the compressing force. The moment the force has ceased to act, it will recoil and recover its normal shape. As a result of this sudden general pressure, the brain is momentarily squeezed, and, on the analogy of the sponge, after its normal capacity for encroachment has been passed, the blood-vessels are emptied and a condition of acute cerebral anæmia is established. Whereas the recovery of the skull is instantaneous, the reflow of blood and the secretion of cerebro-spinal fluid into the brain is a more gradual process and recovery is slow. These must be regarded as the changes which are intimately concerned with the production of concussion. Apart from these general effects, the brain may be bruised at the point struck, the so-called "direct contusion," or by means of a wave of repercussion against the skull diametrically opposed the so-called "polar contusion" or "contre coup." Although the dural septa tend to dissipate these forces, evidences of the path of this wave remain as small and scattered areas of contusion within the brain substance.

As the result of trauma, the brain space may be encroached upon by means of such internal agencies as hæmorrhage, œdema, air, foreign bodies, and, in the later stages, sepsis. This pressure may be general or local in its effect upon the brain substance and leads to an embarrassment of the intracranial circulation. The effects of local pressure are those of cerebral disease generally, but are rarely encountered in these cases. The first effect will be the production of a zone of venous compression in the brain beneath it. Further increase in this pressure will produce, in addition, a deeper zone of venous obstruction. The tissues in this zone will be subject to a state of relative anoxæmia, and would give rise to such symptoms which are associated with cerebral irritation. Any further increase of the pressure will produce a still deeper zone of capillary compression, and the symptoms associated with such arterial anæmia are coma and paralysis.

#### SYMPTOMS

*Concussion.*—Concussion may be defined as a temporary suspension of the cerebral functions following immediately on an injury and lasting a variable time with recovery in twenty-four hours. It follows directly on a sudden compression of the brain with displacement of cerebro-spinal fluid, the loss of consciousness and flaccid paralysis being due to cerebral anæmia. Recovery begins from the medullary centres upwards, usually initiated by the reflex act of vomiting, and the other cerebral functions recover more gradually. There is complete amnesia for the period of unconsciousness. It is important at this time for the patient to be under skilled and competent observation. Following concussion, there is a lucid interval, during which time the patient becomes mentally rational, but it may be so transient as to pass unnoticed, and the patient may pass directly into coma either from severe cerebral compression or damage to the bulbar centres.

*Cerebral contusion.*—There has been a good deal of ambiguity with regard to the various clinical conditions which constitute “cerebral irritation.” So, for purposes of clearer description, it is advisable to follow the classification adopted by Symonds, of major and minor contusions.

*Major contusion.*—This presents a picture of a patient who is stuporose, restless and irritable. It follows on an injury sufficient to cause concussion from which the patient recovers after a variable time, and passes into a state of stupor. He lies curled up in bed. At times he is difficult to rouse, and at other times resentful of interference, noisy, disorientated and violent. This condition may persist for weeks with alternating periods of lucidity and clouded consciousness, of which there is amnesia, a condition to be distinguished from the complete unconsciousness of coma. Lumbar puncture will reveal increased pressure, as registered by means of the spinal manometer, and blood may be present in the fluid.

*Minor contusion.*—Minor contusion is characterized by headache, giddiness, and mental disability. This condition may arise after an injury with or without concussion, or follow as a sequel from major contusion. In the former, it follows directly or may be delayed for several weeks. Headache is generally intermittent and referred to the site of injury, although at times it may be continuous with exacerbations. It is markedly affected by posture and by alteration of posture, physical exertion and mental stress, and is often aggravated by lying down. Giddiness is similarly affected by changes of posture. Mental disability, such as defective memory, inability to concentrate and indecision may occur, and is often associated with insomnia. In either form of contusion, focal symptoms are rare and their localization is of cerebral disease generally, although they may be the origin of such conditions as permanent mental change and epilepsy.

The latter are usually of the Jacksonian type, and in the early stages may be in the nature of a passing symptom, though their later appearance is of a more serious and permanent nature. Meningitis, cerebral abscess, and chronic sub-dural hæmatoma are liable to follow head injury at a much later date.

*Compression.*—The principal features of compression are coma and paralysis, unequal pupils, stertorous respiration, slow pulse and high blood-pressure. It indicates a progressive interference with the intracranial circulation, generally from hæmorrhage. The hæmatoma is always a local lesion and affects one part of the brain more than the rest, consequently it can give rise to clinical symptoms varying according to its situation. In the early stages, according to our pathological dicta, the symptoms will be those of irritation—venous stasis, and, later, paralytic—due to anæmia from capillary compression, and these symptoms may coexist as one part of the brain is more affected than the other. It is convenient to tabulate these symptoms, briefly, as they affect the hemispheres, mid-brain and medulla :—

	<i>Irritative.</i>	<i>Paralytic.</i>
<i>Hemispheres</i>	- Irritability, stupor, restlessness.	Coma.
<i>Motor cortex</i>	- Jacksonian fits	- Hemiplegia. Hemiparesis.
<i>Mid-brain</i>	- Contracted pupil	- Dilated and fixed pupil.
<i>Medulla</i>	- Vomiting	-
<i>Respiration</i>	- Slow stertorous breathing.	- Shallow irregular respiration.
<i>Cardia</i>	- Slow pulse	- Rapid weak pulse.
<i>Vasomotor</i>	- Raised blood pressure.	- Falling blood pressure.

Bulbar symptoms are evidence of advanced compression and are always of serious import.

*Signs of fracture of the base of the skull.*—For clinical purposes it is convenient to classify fractures into those of the anterior, middle and posterior fossæ, and correlate with each of them the signs of fracture, which are :—(1) escape of blood ; (2) escape of cerebro-spinal



fluid and brain matter; (3) injury to nerves; (4) infective conditions.

*Symptoms.*—The main symptoms are as follows :—  
*Anterior fossa* : Escape of blood and cerebro-spinal fluid into the nose, which escapes externally or is swallowed, bleeding into the orbit causing bruising of the lids—"black-eye," sub-conjunctival hæmorrhages and proptosis. The olfactory and optic nerves are both liable to injury. Infective complications, meningitis or abscess may follow, whether the frontal sinus is involved or not. *Middle fossa* : Leakage of blood and cerebro-spinal fluid into the mouth and through the external auditory meatus. The sixth and seventh nerves are commonly injured, and to a lesser degree the eighth. Otitis media is apt to follow rupture of the tympanum, and sepsis may spread through the fracture giving rise to extradural abscess, meningitis and cerebral abscess or sinus thrombosis. *Posterior fossa* : Leakage and bruising under the muscles of the back of the neck. Injury to the seventh and eighth nerves, but the ninth, tenth, eleventh, and twelfth are very rarely involved. Infection is uncommon.

#### TREATMENT

The surgical treatment of head injuries, apart from the early disinfection and excision of compound injuries for limitation of the spread of sepsis, concerns mainly to the relief of intracranial tension from whatever source. All cases should be put to bed at once under expert nursing after thorough and repeated neurological examination.

*Concussion.*—In a case of simple concussion recovery will invariably be complete within twenty-four hours. It is necessary to warn the patient, or his friends, that a period of three weeks complete rest is essential, and that the return to normal life should be gradual. The liability to subsequent headaches is often determined by the thoroughness to which this regime has been

adhered. This headache may be so severe and persistent as to necessitate decompression at a later date. Direct surgical treatment during the first twenty-four hours of concussion is called for only by the onset of coma and paralysis after a lucid interval.

*Major and minor contusion.*—For this condition, rest in bed, preferably in the sitting position, and sedatives are indicated. The intracerebral disturbances in these cases are due to increased tension, and the amount of this tension can be measured and controlled by the spinal manometer. Treatment should be directed to the reduction of this pressure. When it is slight, mag. sulph. daily by mouth will suffice. In severe cases the choice lies between mag. sulph., 3 oz. in 6 oz. of water per rectum, or hypertonic saline, 50–100 c.cm. of 15 per cent. solution, administered intravenously and repeated if necessary every two days.

A more rapid effect can be produced by means of lumbar puncture, and by drawing off enough till the spinal pressure reaches normal, and repeating if necessary. When symptoms such as maniacal delirium are protracted, sub-temporal decompression, in non-localizing cases, afford a more rapid resolution of the cerebral œdema and means of escape for the surface hæmorrhage. For unrelieved contusion headache, decompression offers good help for recovery. The onset of the same symptoms after the first twenty-four hours is indicative of a late arterial hæmorrhage, or the formation of a sub-dural hæmatoma.

*Compression.*—For compression operation is the only treatment available, and it is more successful when performed in anticipation, i.e. before compression sets in. It not only allows removal of the hæmatoma, but provides an exit for further oozing, for the ligation of any bleeding vessel, and relieves the tension produced by œdema and contusion.

Within the first twenty-four hours, concussion

obscures the true pathology, but if after partial or complete recovery from it, the patient sinks into coma or paralytic symptoms develop, arterial hæmorrhage is almost certainly present. This hæmorrhage may be extradural, subdural, intracerebral or intraventricular, and it may gravitate below the tentorium or it may be bilateral. Extradural hæmorrhage is nearly always in the middle fossa from laceration of the middle meningeal artery, and is more likely to be associated with a well-marked lucid interval following concussion. Of the others, subdural hæmorrhage is the commonest; the lucid interval is usually of shorter duration, and irritative symptoms predominate. Blood may be recovered in the spinal fluid. Intracerebral, intraventricular and bulbar hæmorrhage are always of serious import.

Where the symptoms are not localizable, subtemporal decompression is the operation of choice, but in the case of gross injury with no local signs and evidence of bulbar involvement, subtentorial decompression should be performed.

Where there are definite localizing signs, such as, for instance, Jacksonian fits, decompression should be performed over that particular area. As a rule, it is better to remove the bone in such cases rather than perform an osteoplastic flap. In all local lesions with depressed fracture operation is necessary. As most of these cases are infected, the wound should be disinfected and the dura incised.

Chronic subdural hæmatoma, even after a trifling injury, is a late sequel of head injury, and is often mistaken for tumour. The presence of xanthochromia and fibrin in the cerebro-spinal fluid is diagnostic. It must be remembered that the hæmorrhage is often bilateral. The possibility of *sepsis* should always be considered, and its presence some distance away from the focus of infection must not be forgotten. Its prevention depends on the thorough disinfection of

the wound and accessory passages when involved in the injury. The symptoms of intracranial extension are latent, and the presence of polymorphonuclear cells in the cerebro-spinal fluid is indicative of commencing meningitis. Later, the protein content may be increased, and it is not necessary to wait for the presence of organisms. Decompression and drainage should be performed over the area, including the route of infection if originating from the middle ear or frontal sinus. Very rarely is it possible to remove a chronic thick-walled abscess intact.

#### ILLUSTRATIVE CASES

*Middle meningeal hæmorrhage.*—T.F., aged 20, crashed into a standing vehicle while riding a motor cycle. He was concussed, recovered consciousness during the same day, and then lapsed into periods of unconsciousness of varying intensity. Pulse rate 50; Respiration 18; Temperature  $100.4^{\circ}$ . There was hæmorrhage into the left orbit, incontinence, aphasia, and frequent involuntary movements of the right arm and leg. The left pupil was larger than the right, and both reacted to light. Five days later a small left frontal temporal osteoplastic flap was turned down and a large extradural clot removed from the temporal fossa. In fourteen days there was complete recovery. The X-ray showed a fracture of the left frontal region above the orbit.

*Sub-dural hæmatoma.*—E.T.D., a plethoric man of 50, with an alcoholic history, sustained a trivial injury to the head four months previously. Ten weeks after this injury there was a gradual onset of headache, which culminated in excruciating pain. At this time his pulse rate was 60, the abdominal reflex was absent, the knee jerk was increased, and Babinski's sign was present on the right side. The discs showed slight venous engorgement. A diagnosis of left frontal tumour was suggested. A wide left temporal decompression revealed a large old green sub-arachnoid hæmatoma, extending over most of the hemisphere, with a recent clot the size of a golf ball in the Sylvian region. This was removed, and the patient's condition did not warrant exploration of the opposite side, where a similar green clot was revealed at the autopsy.

*Delayed sepsis; injury without fracture.*—H.F., aged 19, a week after his return to school from measles, fainted and fell, sustaining a cut over the right eyebrow. Eleven days after, his condition became worse; the wound was inflamed, and his upper lid was incised and drained. His mental condition became dull, he was incontinent, and spasms of uncontrollable twitchings developed in the left arm and leg. Slight left-sided facial paresis and Babinski's sign on the left side were present. Cerebro-spinal fluid was normal. Pulse rate 104; Respiration 26; Temperature  $104^{\circ}$ . A small area of bone

was removed from the right side, and, on incising the dura, thick flaky pus was seen extending up from the anterior fossa. In the region of the arm centre there was a small collection of thinner pus, which was bulging the dura, and this was removed by suction and a small drain put in. After operation, there was acute delirium, echolalia and verbigeration. The organism was found to be a hæmolytic streptococcus, and anti-scarlet fever streptococcal serum was administered. At the end of a week, the temperature was normal, and the patient a year later is in excellent health.

*Delayed sepsis with fracture ; communication with frontal sinus.*—A.A., aged 26, crashed into a lorry while riding a motor cycle, and sustained a depressed fracture of his left orbit. One month after, he developed general signs of meningismus, and the cerebro-spinal fluid showed the presence of pus cells, and no organisms were seen. The frontal bone over his orbit, which had several depressed fragments, one of which communicated with the frontal sinus, was removed. On incising the dura, sero-pus was found covering the frontal lobe, which was removed by suction. The patient made an excellent recovery.

# Fractures of the Skull in Children

By CECIL P. G. WAKELEY, F.R.C.S., F.R.S.E.

*Surgeon to King's College Hospital and the Belgrave Hospital for Children; Consulting Surgeon to the Maudsley and Hammersmith Hospitals.*

AS a whole the prognosis in fractures of the skull occurring in children is more favourable than it is in adults. In very young children under the age of two years the prognosis is not good, since the venous sinuses situated inside the skull are liable to be lacerated. Should such a case not terminate fatally, there is considerable danger of some consequent spastic paralysis. From the age of two until twelve the prognosis is good, since fractures of the vault of the skull do not usually extend into the base. Further, there is less likelihood of hæmorrhage from the meningeal vessels, as, the inner table of the skull not being fully formed in young children, these vessels are not enclosed in osseous canals.

The prognosis and mortality in fractures of the skull in children depend almost entirely on the question of associated injury to the intracranial contents. There are certain peculiarities in the skull of a child, which account for the better results obtained after fracture than in adult cases. The membrane bones of the vault of the skull are very elastic, consequently any trauma applied to them results in a bending, rather than a breaking. Intervening between the individual skull bones of a child is a considerable amount of cartilaginous or fibrous tissue. This structural feature limits the transmission of the disturbance caused by trauma from one area of the skull to another, and the injury thereby tends to be

localized.

In children the dura mater is more adherent to the skull bones and therefore limits, to a great extent, any extradural hæmorrhage. There is very little diploë and for this reason fractures of the outer and inner tables of the skull are indistinguishable; if one table is fractured the other must necessarily be involved as well. The meningeal vessels of children are relatively very elastic, and this characteristic feature tends to arrest hæmorrhage when a vessel outside the dura mater is injured. Again, pressure due to an intracranial collection of blood is less likely to cause damage to the brain of a child than to that of an adult.

*Vault fractures* are the common type met with in children. They usually are linear in outline and do not tend to extend into the base. They are always the result of direct violence. Very rarely a traumatic cephalo-hydrocele may result in cases of fractures of the vault, but in these cases the amount of trauma is excessive. The condition is characterized by the formation of a fluid swelling under the scalp, which pulsates synchronously with the heart beat and has a definite impulse on any expiratory effort. It varies in size from time to time, and is sometimes partially reducible. It contains cerebro-spinal fluid, and communicates with one of the lateral ventricles.

*Basal fractures* are uncommon in children, and, when they do occur, are in most cases the result of such severe trauma as to cause instant death. When, however, they occur in the anterior fossa, as a result of injuries to the face or forehead, the prognosis is much more favourable.

#### CLINICAL SIGNS OF FRACTURES OF THE SKULL

These are generally characteristic of fractures in other situations, e.g. pain, swelling, and, occasionally, deformity, should the fracture be depressed. It must always be remembered, however, that any fracture of

the skull in children may be accompanied by certain well-known conditions, the most important of which are the following : (1) Shock. (2) Concussion of the brain. (3) Laceration of the brain. (4) Compression of the brain. (5) Cerebral œdema.

(1) *Shock*.—Any fracture of the skull in children produces a considerable amount of shock, and this usually produces unconsciousness from the onset. By the time the child is examined at the hospital, or at home, the temperature is subnormal; the pulse is rapid, weak, and often irregular. The skin is cold and clammy. There is a definite fall in the systolic blood pressure, while the respiration rate is increased. The actual period during which the child suffers from shock, varies from eight to twelve hours after which time the child may gradually and progressively improve, or, on the other hand, cerebral compression or œdema may eventually ensue. If improvement takes place, the pulse rate returns to normal, the respiration rate falls, and the little patient regains consciousness.

(2) *Concussion*.—This results from a contusion of the brain tissue, which generally produces a certain amount of ecchymosis or bruising of the brain. The conditions of shock and concussion so often co-exist that it may be difficult to differentiate one from the other. However, in some cases, concussion may follow a trivial head-injury, where no shock is evident. Perhaps the commonest signs of concussion in children are giddiness, headache, and vomiting. If shock is present, the unconscious state is prolonged and may last three or four days. There is incontinence, and the temperature remains subnormal. The return to consciousness may be followed by headache and nausea, and sometimes loss of memory.

(3) *Cerebral laceration*.—The most characteristic sign which accompanies laceration of the brain is pyrexia and, should the motor area be involved, there may be



muscular twitchings as well. As it is impossible for the brain to be lacerated without resultant shock and concussion, the symptoms of cerebral laceration generally become manifest after the signs of shock have passed off. If the signs of concussion are present together with pyrexia, it may safely be assumed that there is some laceration of the brain, for concussion in itself is never accompanied by a rise of temperature. Generally speaking, cerebral laceration engenders irritability and mental excitement on the part of the patient to a greater degree than other lesions.

(4) *Compression of the brain.*—This is most commonly due to hæmorrhage inside the skull; it is rarely due to a depressed fracture of the skull. Sometimes, however, the two coincide. As a rule the symptoms of compression become manifest when those of shock are beginning to pass off, and the systolic blood pressure is rising. As the signs of shock are passing off, the child becomes drowsy and complains of headache, probably due to the expulsion of cerebro-spinal fluid from the cranial cavity. If the compression increases, venous stasis, due to obliteration of the thin walled veins, ensues. This is manifested in the patient by restlessness and delirium. A lumbar puncture will demonstrate that the cerebro-spinal fluid is under tension. The respiration rate is increased and the pulse rate falls. If the compression continues cerebral anæmia will be produced; the pulse is slow and its tension high, respiration becomes stertorous and gradually merges into the Cheyne-Stokes type. This will be followed by coma and death, unless the compression is relieved.

(5) *Cerebral œdema.*—This may be looked upon as a local congestion with swelling of the brain tissue and is consequent upon bruising due to the trauma. Accompanying this congestion is a serous effusion into the subarachnoid space. As a rule, cerebral œdema occurs at a definite interval after fracture of

the skull. This interval is often termed "lucid," because the symptoms of primary shock may have passed off and the child seems well on the way to recovery. If, however, symptoms of compression appear, the child, after a time, becomes gradually unconscious or semi-conscious.

#### TREATMENT

The treatment of fractures of the skull may necessitate the treatment of concussion and compression as well as of the fracture itself. It may be stated definitely that conservative treatment, in the majority of cases, will suffice. Linear fractures of the vault require no treatment, except that of the accompanying concussion. Children after concussion are liable to be extremely irritable and toss and turn about in bed. Morphia should never be given, as it depresses the respiratory centre, and the patient may again become unconscious. Generally speaking, potassium bromide and chloral per rectum will be all that is required. Hypertonic salt solution is especially valuable in these cases, it can be given per rectum or intravenously. Hypertonic sodium chloride promotes resorption of the cerebro-spinal fluid, and consequently lowers the intra-cranial pressure. Instead of sodium chloride, magnesium sulphate in a 25 per cent. solution may be given per rectum, and is quite as efficacious. The administration of a hypertonic salt solution is the best means at our disposal for the treatment of head injuries, and it forms a real and definite advance in the treatment of such cases.

Lumbar puncture will also reduce intra-cranial pressure in cases of fracture of the skull. Cerebro-spinal fluid should be withdrawn slowly every three hours. In these cases it is always advisable for the amount of fluid withdrawn to be controlled by manometric readings. In children, lumbar puncture often causes considerable disturbance, and nowadays

is rarely necessary, its place having been taken by hypertonic sodium chloride.

In cases of simple depressed fractures no immediate operative treatment is necessary. Shock and concussion should be treated and, two or three days after the injury, the depressed fracture should be elevated. (See Figs. 1 and 2.) All depressed fractures in children

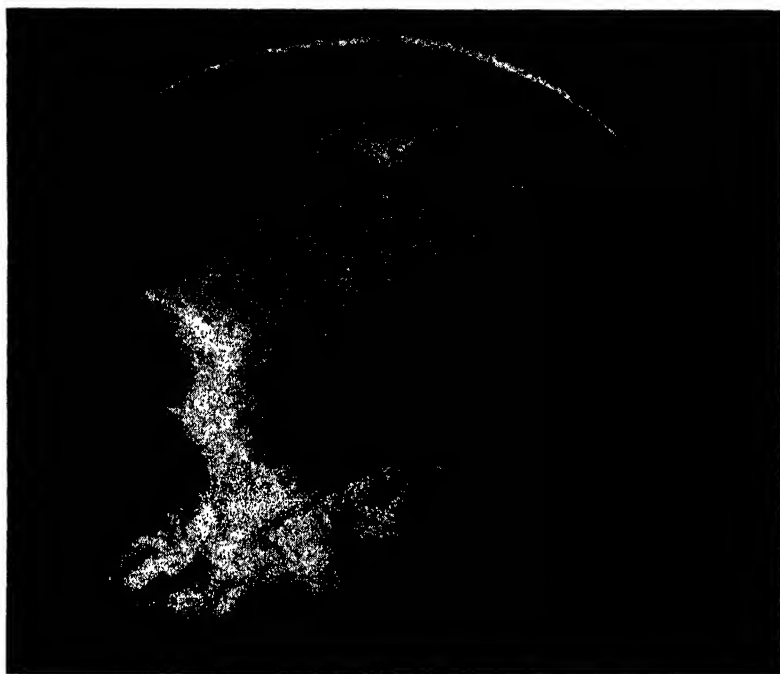


FIG 1.—Depressed comminuted fracture in the fronto-parietal region causing Jacksonian fits.

should be operated upon within a week of the injury. If left for a longer time, there is always a liability of epilepsy ensuing at a later date.

A large scalp flap is turned down exposing the fracture, and a small trephine opening made, just to one side of the depressed area. The trephine disc is removed and a dura mater separator is inserted between the bone and the dura mater. In most cases this will form quite an efficient elevator and will raise the depressed area to its normal position. As

a rule, very little bleeding accompanies this procedure. The dura mater should be examined to see if it has been damaged. The trephine disc is replaced, and the scalp wound closed with interrupted silk worm gut sutures. There is no necessity for any drainage.

Compound fractures of the vault of the skull always call for immediate treatment in order that possible

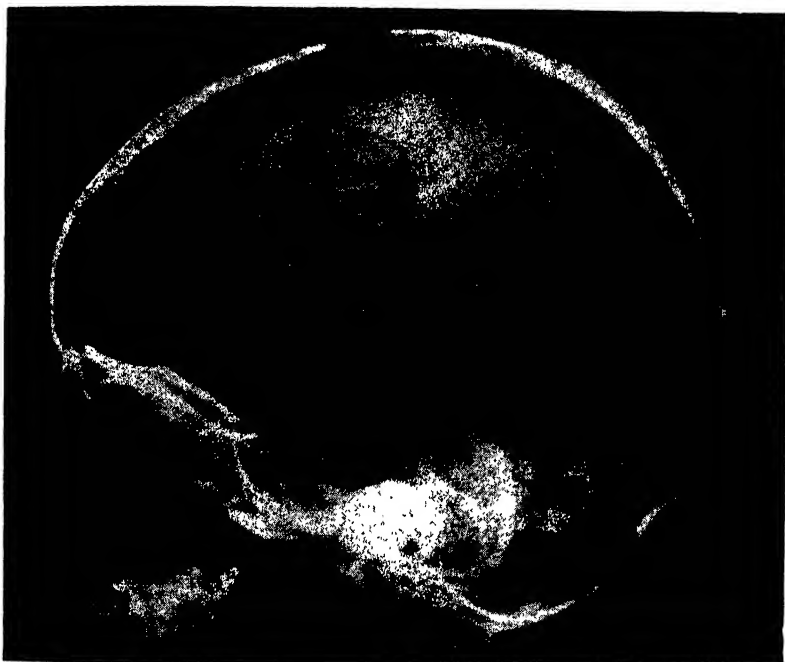


FIG. 2.—Skiagram after trephining and elevation of the bone fragments.  
Child aged 8, made an uninterrupted recovery.

infection may be prevented. Any delay in dealing with these fractures may result in meningitis, extradural or cerebral abscess, or even osteomyelitis of the skull. After shaving the whole head a very thorough cleansing of the scalp is necessary. The wound edges are completely excised and any dirt or hair carefully removed. The fracture is examined and, should it prove a simple linear one, no further treatment is required. The scalp is sutured without drainage. On the other hand, if the fracture is depressed, it must

be elevated, and the dura mater examined. If the dura mater be torn, the underlying brain is carefully examined, and any blood clot or debris removed. The dura mater is drawn together by a few interrupted sutures, and a small drainage tube, reaching the dura mater, inserted. This drainage tube can usually be removed after three days. In all cases of compound fractures of the skull anti-tetanic serum should be

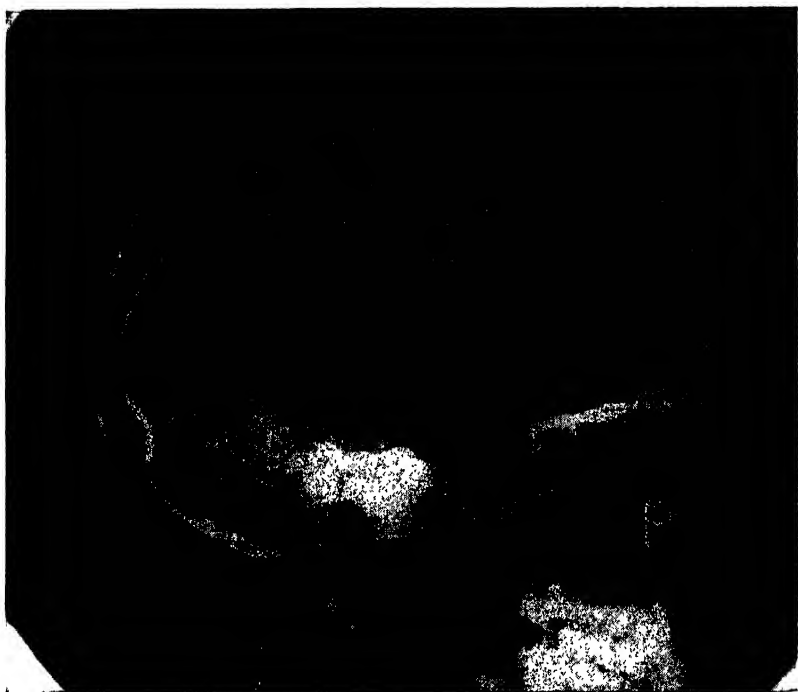


FIG. 3.—Skiagram showing large linear fracture originating in the occipital region and passing downwards and forwards towards the base of the skull.

given. It is also advisable to give urotropin, every four hours, for several days after the operation. If this drug is given by mouth it makes its appearance in the cerebro-spinal fluid in the form of formaldehyd, and as such, helps to counteract any threatened infection of the meninges.

Fractures of the base rarely require any operative interference, unless there are signs of intra-cranial hæmorrhage or œdema, in which cases a decompression

operation is requisite.

In all cases of fracture of the skull in children it is essential to insist upon prolonged rest. This is a most important part of the after treatment, and if neglected, which is far too often the case, may be the

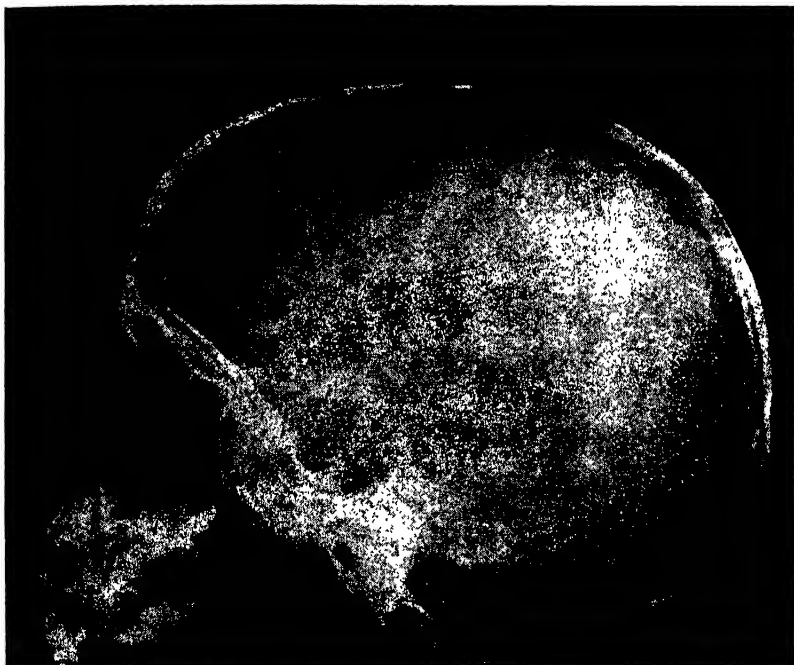


FIG. 4.—Linear fracture of the frontal bone.

cause of much subsequent trouble. After fracture of the skull the mother is often far too anxious to get the child back to school, and at a much too early period. In such cases, it is the duty of the practitioner to enforce prolonged rest for a month or six weeks at least.

# Injuries of the Spine

By JULIAN TAYLOR, M.S., F.R.C.S.

*Associate Surgeon, University College Hospital ; Assistant Surgeon,  
National Hospital for Nervous Diseases, Queen Square.*

**F**RACTURE of the spine presents in a sense a more complex problem than does cranial injury, because the neurological aspect, of sole importance in the head, is accompanied in the case of the spine by what for the want of a better word may be called the orthopædic. In both injuries the neurological element is basically the same, though its evolution and manifestations are more varied in the brain owing to intricate structure. In head injuries the sole importance of fractured skull is that of a path opened for the possible passage of infection or air into the cranial cavity, while fracture of the spine is of itself a potential source of crippling disability, infection being practically limited to gun-shot wounds, now happily rare. We have therefore to consider our subject in respect of the spinal cord, its injuries and recovery, and of the vertebral column, its fractures and processes of union. An exhaustive account is obviously impossible within our limits, but a broad consideration of these aspects in the principal clinical varieties of spinal injury may assist the reader to form a basis for prognosis and treatment. The increasing diffusion of good radiography demonstrating the existence of many spinal fractures unaccompanied by cord injury, is a temptation to consider the vertebral aspects first, but the calamitous consequences of cord injury compel an orthodox beginning with the central nervous system.

## ANATOMY AND MORBID ANATOMY

The spinal cord extends from the first cervical to the first lumbar vertebra, the whole range of spinal

nerves being given off in this length, so that in the intraspinal course of the nerve roots from above downwards there is an increasing obliquity, greatest in the region of the cauda equina. The cord is suspended in a bath of cerebro-spinal fluid in the spinal theca, which in turn lies in the protective soft and vascular extra-dural fat that intervenes between the theca and the vertebral canal. Trauma may be inflicted on the cord, on its meninges, or on the spinal nerve roots, and may result in contusion, hæmatoma, laceration, or destruction from compression. In any case the clinical consequences are those of alteration of function and the exact anatomical effect of trauma is thus a matter of deduction from physical signs. Such anatomical effects are naturally the result of pressure in some form, whether momentary, immediate and permanent, or delayed and attributable to bony changes in the process of union in the vertebral column. Further, the effects themselves may be immediate or may be delayed and due to secondary changes in the nervous elements.

*The spinal nerves* are clearly likely to be damaged in their intervertebral foramina, *the cord* obviously in the vertebral canal. The cord may be pressed on momentarily as the result of sudden acute flexion of the column with or without dislocation or fracture, or dislocation or fracture may so narrow the canal as to compress the theca permanently. The canal is widest in the cervical, lumbar, and sacral regions, narrowest in the thoracic, and it is in this last region that spinal cord injuries are most commonly severe. The available space, together with the various protective layers, tend to isolate the cord from displaced bone fragments, so that the dura is frequently unruptured although the cord be damaged.

#### PATHOLOGICAL CONSEQUENCES OF CORD INJURY

Interruption in the conductivity of the cord may



be due to local destruction, to hæmorrhage, to œdema occurring as part of the reparative processes, or may be the result of pressure, perhaps momentary, unassociated with any of the first three. Unlike what is seen in the brain, hæmorrhage as a primary manifestation in the cord is not commonly extensive, being often limited to small patches of ecchymosis, though subsequent softening of these is often seen. A common late effect in the cord is that of hæmorrhage usually in the grey matter and often extending for considerable distances above and below the site of trauma, increasing progressively from the moment of injury, or occurring as the result of softening perhaps ten days later. To such hæmorrhages the name hæmatomyelia is given.

Where there is any serious pressure on the theca the circulation of cerebro-spinal fluid is obstructed so that the theca below is tense and non-pulsatile. The theca above may also be tense for a short distance, and with this latter cerebro-spinal fluid disturbance, symptoms and signs referable to segments of the cord above the site of injury may be seen.

*The meninges* may be damaged without the cord suffering, and though hæmorrhage into the spinal arachnoid does not commonly give rise to serious symptoms, the late phenomena of chronic serous meningitis are well known.

#### PATHOLOGICAL CONSIDERATIONS REGARDING RECOVERY

When once an interruption of the whole or a part of the cord has occurred, and is of such severity as to result in the death of nervous elements, no regeneration is possible. *It follows that recovery is seen only in respect of those structures that have been injured so severely that their functions have been suspended, but so slightly as not to have suffered destruction.*

*Process of recovery.*—Where the cord has suffered crushing without hæmorrhage or laceration, recovery

consists simply in a return of conductivity. Where there is hæmorrhage or contusion, a local œdema ensues as part of the reparative process causing vascular effects in the cord which result in loss of conductivity. Repair in the central nervous system is notoriously slow and thus recovery may be delayed for long periods.

*Duration of recovery.*—It is hard to be precise but it may be said that when there has been a momentary crush without hæmorrhage or much contusion, recovery should be rapid and its onset should be delayed not more than three weeks. Where there is continued pressure from clot, reparative process, or bone, abeyance of function may go on for long periods without death of the nervous tissue. After such pressure has been relieved by absorption of clot or possibly by operative removal of bone, recovery should have proceeded to its farthest limit in two to three months. The period of absorption of clot or subsidence of œdema is obviously impossible to determine in most cases and these periods are approximate and possibly inaccurate.

#### THE CLINICAL EFFECTS OF CORD INJURIES

Transection or complete interruption of the cord results in loss of function of the parts up to the level injured. Such loss of function is due at the site of injury to direct effects upon the nerve cells of the grey matter and possibly upon the corresponding roots, and below that level to tract effects. In many cases the two varieties of effect are clinically merged but in some they are clearly distinct. The lower limbs are flaccid and powerless, no reflexes being obtainable, there is complete loss of sensation, and there is retention of urine. Such severe injuries are usually associated with a considerable degree of shock and it may be difficult within the first few hours to assess their gravity. Injuries to different levels in the cord naturally have different results, and there are certain striking clinical pictures among which the following

are noteworthy.

*Injury above the fourth cervical segment* causes death from asphyxia, all the nervous paths to the lungs being interrupted.

*Injury to the upper part of the cervical enlargement*, i.e. about the level of the fourth cervical vertebra, permits the phrenic nerves to escape and thus there is seen complete flaccid quadriplegia.

*Injury to the lower part of the cervical enlargement*, i.e. about the level of the fifth and sixth cervical vertebrae results in damage to segments 7 and 8 C and possibly Th. 1, 5 and 6 C escaping. The consequence to the upper limbs, described by Thorburn, is the converse of bilateral Erb's palsy, as the muscles supplied by 5, 6 C are unaffected and unopposed by the paralyzed groups supplied by 7, 8 C and Th. 1. The shoulders are thus held in abduction, the elbows in flexion, the forearms supinated, and there soon appears wasting of the flexors of the wrist, and of the small muscles of the hand. There may also be damage to the sympathetic outflow with resulting contraction of the pupils and narrowing of the palpebral fissures. Below the upper limbs there is a complete flaccid paralysis, and there is sensory loss up to and including the ulnar border of the arm, forearm, and hand. Respiration is carried on by the diaphragm and by the accessory muscles of the neck. There is here a mixed picture of tract effects and of those of local pressure on grey matter as evidenced by the wasting of muscles. When spasticity later appears in the lower limbs the contrast between the two varieties of nervous effect is more obvious.

*Injury to the thoracic region* is characterized by flaccid paralysis and sensory loss below the level of trauma.

*Injury to the lumbar enlargement and cauda equina.*—These may for present purposes be considered together. Their characteristic manifestations are paralysis, atony, and wasting of the lower limb muscles, anæsthesia of

the lower limbs and buttocks, abolition of reflexes, and retention of urine.

The foregoing are the effects of complete transverse lesions of the cord at different levels. Many injuries cause *incomplete lesions* though in the early days of recovery these may appear to be almost complete. It is theoretically possible for incomplete lesions to appear complete to begin with, but unfortunately it is usually found that injuries showing immediately no sign of incompleteness rarely proceed to any recovery. The fact that a lesion is incomplete and therefore has some chance of recovery, is most often shown by absence of complete sensory loss, and in general it may be said that in the cord the motor paths are the more sensitive and the earlier to lose function in response to pressure, the sensory paths the less sensitive and the longer resistant.

All degrees of loss of function are seen in incomplete injuries, from complete paralysis with partial anæsthesia, to temporary paralysis without anæsthesia lasting only a few minutes. Also as has been noted, the cord may not be injured at all, nerve roots alone suffering trauma.

*Hæmatomyelia*.—This is an important form of injury and it may be that a severe crush, during recovery, may show that it is present by the character of the signs presented as the sensory change lessens, or it may be that during the days following a crush a progressive hæmorrhage may occur, so that the signs of hæmatomyelia may become manifest by increase, rather than by selective reduction of the signs. The characteristic sign of hæmatomyelia, analgesia and loss of temperature sense in the distribution of the affected segments, is due to the fact that such effusions of blood are most frequently central in the cord, and thus affect the pain and temperature fibres as they cross from the homolateral to the contralateral side almost immediately they enter the cord. An extensive

hæmatomyelia may also affect the pyramidal tracts.

*Visceral effects of spinal injuries.*—In the hours following the occurrence of a lumbar injury, it is not uncommon to find increasing abdominal distension. This together with the shock associated with the injury may give rise to a suspicion of the presence of visceral injury. With rising pulse rate and increasing abdominal distension, the decision as to the necessity for exploratory laparotomy may be extremely difficult.

#### THE CLINICAL PROGRESS OF INJURIES

It has been stated that in complete transection of the cord no recovery is possible. This is not however true of the cauda equina, peripheral regeneration being here possible. In complete injuries there is later on a resumption of reflex activities by the cord the muscles become spastic, the tendon reflexes return, the plantar responses become extensor, and cutaneous stimuli to the limbs cause movements over which the patient has no control. The muscular spasm results in fixed flexion of the hips with adduction, and flexion of the knees and ankles which eventually becomes contracture. Such flexor spasms are evidence of the presence of complete lesions and are thus of serious import. "Automatic micturition" appears with a return of reflex activity and the bladder begins to empty itself though incompletely. The beginning of these changes is usually seen during the two to three weeks following the accident.

In partial injuries the first sign of returning function is usually seen during the first two or three weeks and is commonly an increase of sensation. It often begins in the distribution of the sacral segments. Later there is return of muscular power and if the injury is a severe one there is also spasticity, but now in extension. Extensor spasms may be produced by cutaneous stimuli. In some incomplete examples evidence of the presence of hæmatomyelia may appear, i.e. dissoci-

ation of sensibility, pain and temperature appreciation being lost at the level of the lesion, usually the cervical part of the cord. All sorts of variations are seen in incomplete injuries, from a rapid and complete return to the normal in mild cases during two or three weeks, to an incomplete return of sensation without muscular power in several months. Patients whose sensation has been preserved but who fail to achieve a return of voluntary muscular power often complain of intense pain associated with involuntary muscular movements, an intractable sequel which is one of the most melancholy consequences of spinal injury and which has even necessitated operative division of the spinal cord above the lesion.

#### THE VERTEBRAL COLUMN

It has already been noted that injury of the cord may be seen in the absence of dislocation or fracture of the spinal column. Some of these cases may be of the nature of dislocations immediately and spontaneously reduced, others are probably simply the effects of hyperflexion of the column and are most common in the neck. Of such perhaps the most striking is the recurrent temporary quadriplegia seen in long-necked persons following sudden flexion of the suboccipital region, and due to pressure of the dens of the axis on the theca. Injuries of the spinal column are of two types, *dislocation* and *fracture*, the majority of the former being complicated by the latter. In *dislocation* the upper of two vertebræ slips forward on the lower, so that the inferior articular process of the upper comes to lie in front of, instead of behind, the superior articular process of the lower. Thus the intervertebral foramen becomes distorted and partially filled by the inferior articular process of the upper vertebra and as a consequence the emerging nerve roots may be pressed upon. The pressure on the theca may be, but is not necessarily, produced by compression between the arch of the upper

vertebra and the body of the lower. In dislocations the inferior articular process may remain balanced upon the superior articular process below and either complete or incomplete dislocation may be unilateral or bilateral. All such dislocations are seen almost exclusively in the cervical region and may of course be complicated by fracture. In unilateral cervical dislocation there appears a fixed rotation of the head towards the sound side, the head also being inclined towards the sound shoulder. In a bilateral dislocation the head is held stiffly forward. An important but rare variety of dislocation is that which occurs at the atlanto-axial joint in young children.

*Fracture* may occur in any part of the vertebra. Spinous and transverse processes may be fractured by direct, indirect, or purely muscular violence, and very rarely a lamina may be thrust forward into the spinal canal by direct violence. Spinous processes suffer most commonly where they are prominent in the thoracic region. Transverse processes are liable to fracture where they have no support from ribs, and where they are subject to great muscular strain, i.e. in the lumbar region, and fracture of both these processes may be associated with more serious injuries to the bodies, and with dislocation. Isolated fractures of processes are uncomplicated by cord injury and are causes of pain in the back; their nature can be elucidated by radiography.

*Fractures of vertebral bodies.*—These are again nearly always due to hyperflexion of the vertebral column together with vertical compression, and most commonly result from the kind of accident in which a great weight falls on the subject's neck. There are several types and there may be in a given injury a number of elements in the anatomical result to the spine.

(i) *Fracture dislocation* : When the body of the upper vertebra slips forward it may take with it a part of the intervertebral disc and a wedge-shaped piece separated

from the anterior part of the upper surface of the lower vertebra. This kind of accident is perhaps commonest in the thoracic region and may be associated with fracture about the manubrio-sternal junction.

(ii) *Compression fracture* : A vertebral body may be comminuted by compression without associated dislocation. Being compressed it assumes a wedge shape. This fracture is commonest in the upper lumbar and lower thoracic regions, and when unassociated with dislocations there is usually no effect on the spinal cord.

(iii) Where fractures are the result of very great violence as in many coal-pit accidents, there may be *complete disruption of the column* at the site of injury so that it may become flail-like.

*Diagnosis.*—Physical examination will often show the nature of the injury. Reference has already been made to the displacements of the head associated with cervical dislocations. Compression-fracture and the majority of fracture-dislocations result in angulation of the vertebral column which, as in many diseases of vertebræ, produces prominence of a spinous process, and there may be also irregularity with lateral displacement of one spine on another. In assessing the importance of such signs it must be remembered that especially in the lower thoracic spine, irregularity of the palpable parts of the spinous processes may be normal, that localized limitation of movement may be hard to ascertain in any region, and that where there is a possibility of fracture, injury to the cord may perhaps be increased or actually produced by too thorough an investigation of movement.

Radiography is obviously a necessity in every spinal injury, but its discussion is the province of the radiologist and is here left in the highly expert care of Dr. Graham Hodgson, three of whose radiograms are illustrative of the injuries under discussion. In the absence of a careful physical examination and sometimes without omitting it, the detection of spinal injuries



without gross cord or nerve injury may be impossible apart from such radiological help. An example of this was encountered some years ago by the writer:—

A girl aged 20 was pitched out of an overturning car, landing on her head. She suffered slightly from concussion of the brain, but recovered immediately. Returning home she found she had some stiffness of the neck, but little notice was taken of this except that a fortnight's massage was instituted. At the end of this time she was better, and well enough to be up and about, although her neck was still stiff. Her first excursion was a visit to her coiffeur, who, during the act of shampooing her head, pressed upon her occiput, flexing her cervical spine somewhat forcibly. Immediately she felt an agonizing pain in the outer part of the arm and in the forearm. Radiography showed a fracture dislocation of the fifth and sixth cervical vertebræ, and physical examination the presence of altered sensation in the distribution of the sixth cervical nerve. She could then by flexing the neck reproduce the pain initiated by the coiffeur. After partial reduction of the dislocation, followed by several months on a plaster bed, her pain had disappeared.

The exact nature of the injury having been demonstrated by the radiologist, it is for the surgeon to correlate such findings with his conclusions as regards the nervous system, and thus to attempt to elaborate a conception of the exact morbid anatomy of the injury to the column and cord.

*Progress of healing in fractures of the vertebral column.*  
—Bony union of the displaced vertebræ is the rule, and in the absence of manipulative reduction must occur more or less in the position into which the accident has thrust the damaged bones. Where there is separation of two vertebræ, as in partial dislocations, with the passage of time the upper vertebra sinks down on the lower owing to plastic accommodative changes in the articular processes and pedicles. Consolidation of spinal fractures should be so complete as to be adequate for weight bearing in about eight weeks. Where there is much comminution or displacement a considerable amount of callus may be thrown out so that compression of both emerging nerves and of the theca may be increased, or actually produced, by the process of union, an unlucky event that is likely to be aggravated

by failure to recognize the presence of fracture and consequent inappropriate treatment.

Having now outlined the main facts regarding the cord and the column, we are in a position to assess the injury as a whole in any given example. The majority of cases suffer from severe shock at the onset, so that examination of their conditions must be short. The possibility of associated visceral injury must be borne in mind, and a decision on this question is more important during the early hours than on the spinal condition, because, as we shall see, there is no question of urgent operation for the latter. But when any uncertainty as to the viscera has been dispelled the patient may be gently examined as regards his spine, rolling him on to his side for this purpose perhaps, so that his spinal and neurological injuries may be determined.

There are certain fairly well-defined types of spinal injury to which reference must be made:—

(1) *Fracture-dislocation in the region of the fifth and sixth cervical vertebræ.*—Bilateral dislocation is most commonly associated with a cord lesion, often incomplete. Unilateral dislocation is uncommon and less likely to be accompanied by cord effects.

(2) *Compression-fracture of the thoraco-lumbar region.*—This is usually accompanied by no nervous lesions, but when there is fracture dislocation, or more extensive fracture, *conus medullaris* or *cauda equina* lesions are often present.

(3) *Fracture-dislocation about the level of the fourth thoracic vertebra.*—This is a serious injury often associated with complete paraplegia. It is also accompanied by severe shock.

(4) *Fractures of processes without encroachment on the spinal canal.* (*Vide p. 92.*)

#### TREATMENT OF SPINAL INJURIES

*The injury to the vertebral column.—Dislocation:*

Unilateral dislocation unaccompanied by cord pressure is susceptible of reduction. This is effected under anaesthesia by a combination of traction on the legs and head and gentle manipulation. It is important that a radiographic picture be available as associated fracture may make reduction difficult or impossible, and manipulation may then produce pressure on the cord. Attempts at reduction should be made as soon and be as gentle as possible. *Fractures*: In general, the treatment of spinal fracture consists of rest in bed or perhaps on a plaster bed. With compression-fracture without cord or cauda injury, an attempt may be made to correct deformity by means of traction and hyper-extension on a frame, the comminuted vertebral body being thus relieved of compressing stress and being possibly opened out again. Such cases must be kept in a hyper-extended position until consolidation has occurred. In the average case, provided the central nervous condition permits, a patient suffering from fracture of the spine may be allowed up after eight weeks.

*The injury to the cord*.—In a fairly severe paraplegia the first signs of recovery are commonly the reappearance of reflex activity in the cord and return of sensation. Recovery must be watched and its progress noted so that arrest after a propitious beginning may be recognized, this being sometimes an indication for operation. The prevention of contractures from uncorrected flexor spasm is an important part of the treatment and is carried out by splints if necessary.

*Bedsore*s.—The incidence of bedsores naturally varies more or less inversely with the skill of the nursing. They are especially likely to occur during the early stages of an injury before the skin has become accustomed to disconnection from the brain. It may be said that nearly all paraplegics have bedsores at some time, though these may heal with surprising facility under treatment. They are frequently absent in

caudal lesions and almost invariably present in conus medullaris injuries. Most nurses have their own infallible remedies for preventing and curing bedsores, but success depends for the most part in the protection of prominences from continuous weight-bearing, and the efficient management of the bladder and rectum. When extensive sloughing and infection occur these must be treated surgically.

*Bladder.*—Retention of urine is most difficult to deal with. The majority of cases suffer from it at first and provided aseptic conditions are available, it is best managed by catheterizing at least twice daily with punctilious cleanliness, the bladder being completely emptied on each occasion. It is well to wash out the urethra, before passing an instrument, with some mild antiseptic such as oxycyanide of mercury 1/4000. When the bladder begins to empty itself, which in complete paraplegia should occur in about three weeks, catheterization must be continued at least once daily to ensure that the bladder is regularly and completely emptied. With the most stringent precautions it is almost impossible to avoid some urinary infection, which is the more dangerous to life from ascending infection of the kidneys, the earlier it comes on. When such infections have become chronic they are less dangerous and many patients live for many years with chronic severe urinary infections without suffering more hurt than occasional bouts of fever. Eventually, however, it is likely that with progressive destruction of the renal tissue, a fatal exacerbation with uræmia may supervene. The most resistant cases of spinal injury so far as urinary function is concerned are those of the cauda equina.

Other less laborious methods of dealing with retention of urine have been employed, but all have their disadvantages. The in-dwelling catheter changed daily is perhaps the least objectionable of these, but urethritis is inevitable with consequent cystitis and ascending

infection. The emptying of the bladder by suprapubic massage is to be unequivocally condemned, owing to the ease with which the atonic bladder wall may be thus ruptured. Suprapubic drainage, ideal as it sounds for the bladder of the permanent paraplegic, is not a highly successful measure owing to consequent wetting of the bed and liability to bedsores.

*Colon.*—The majority of paraplegics suffer at some time from constipation and abdominal distension. Constipation is no great evil as it masks incontinence of fæces and enables the nurse to open the bowel by means of an enema every other day. Distension may be hard to deal with and may necessitate the use of turpentine enemas and purges, but the production of diarrhœa is to be avoided when the anus is incontinent.

#### OPERATIVE TREATMENT OF CORD INJURIES

The only thing that operation can do is to relieve pressure on the cord from displaced bone or callus. Incision of the cord as an early measure for relief of tension by letting out blood clot is not to be recommended and it was noted earlier that large effusions of blood are unusual. The only possible approach to the cord at the present time is by laminectomy, and in certain cases this is indicated. It has been insisted that recovery of destroyed nervous tissues is impossible, and thus operation is not indicated for relief of pressure unless an injury be incomplete. Indications for operation may be given as follows:—

(1) An incomplete injury where the process of recovery after a propitious beginning becomes arrested, especially if lumbar puncture shows the presence of cerebrospinal fluid block (Queckenstedt phenomenon), and especially if the cauda equina be the site of injury.

(2) Where a lamina is thrust forward by direct violence and can be shown to be in such a position as to be capable of pressing on the theca. This is the only indication for an early decompressive operation, which

of course is contra-indicated by the presence of a complete lesion.

(3) Operation is indicated in compound injuries and for the removal of foreign bodies.

Precocious interference has been urged in the past, but such a procedure is contra-indicated by the following considerations: (a) Spinal injuries cause severe shock, and patients suffering from such recent trauma are in no condition to stand the moderately severe operation of laminectomy. (b) *Incomplete lesions suffer no permanent harm* from pressure lasting as long as two months, so that time up to this period spent in deciding whether operation may or may not be necessary is not prejudicial to ultimate complete recovery. (c) *In fracture-dislocations there may be considerable damage to the anterior parts of the vertebræ concerned.* Laminectomy may remove an important element in the local stability of the vertebral column if performed with precocity, though if we wait until some consolidation has occurred, there is no such danger. This is one of the very few exceptions to the rule that laminectomy of whatever extent does not prejudice the stability of the column.

Operation is, perhaps, most often indicated in thoracolumbar fractures. It consists in laminectomy with exposure of the dura, a procedure that must be carried out with deliberation as the theca may be displaced towards the surface by the injury. All bony pressure is relieved, and if it can be demonstrated that a cerebrospinal fluid block has been thus abolished, by the appearance of pulsation previously absent from the theca below the site of injury, there is prospect of benefit accruing. It is theoretically possible to suture the nerves of the cauda equina with recovery of function, but this is rarely possible in practice. In general it is advisable to leave the dura unopened if it be thought that pressure has been relieved. Operation is also indicated apart from cord injury, and it is sometimes

advisable to remove fractured transverse and spinous processes where these are causing persistent pain. Occasionally where there is persistent pain on movement in united fracture of the column, it may be advisable to fix the injured part by grafting.

*Prognosis.*—All degrees of neurological recovery are seen in cord injuries, and in each case there is a corresponding crippling. Where there is complete neurological recovery the spinal fracture may be the cause of severe disability, especially in the lumbar region. Thus it is common for sedentary workers to return to normal life after neurological recovery, but is almost unknown in miners and others who live by muscular work, which folk have a less happy outlook and rarely return to their original tasks. In them the final disability is commonly pain at the site of fracture, often due to osteo-arthritic changes in the injured and sometimes malunited spine.

# Injuries to the Shoulder

BY E. P. BROCKMAN, M.CHIR., F.R.C.S.

*Orthopædic Surgeon to the Westminster Hospital ; Assistant Surgeon to the Royal National Orthopædic Hospital.*

THE keynote to the successful treatment of all injuries of the shoulder is the prevention and treatment of limitation in movement of this joint which results from an injury. Should treatment be started without regard to this the patient will suffer loss of function longer than is necessary and the practitioner responsible will experience considerable difficulty in restoring his patient to full activity. Injury of the shoulder joint is responsible for more pain, suffering and time lost from work than almost any other type of injury which occurs.

Our principal difficulty in the treatment of these injuries lies in the steering of a course midway between movement and rest. The latter being essential to enable repair of the damaged structures to take place and the former to prevent stiffness and the formation of adhesions. The first principle, which we have to learn in the treatment of all joint injuries, is that if the patient can actively move the joint it can only be for good. The presence of a bone injury in the neighbourhood, as will be pointed out later, does not necessarily prohibit any movement of the joint itself.

Whilst passive movement has its place in the restoration of function of a joint, it is of little value in comparison with an active movement performed by the patient himself, if necessary with the assistance of a masseuse. And in shoulder injuries in particular assisted active movement is infinitely more valuable than any passive movement, which may even delay recovery. Passive movement is out of the control of the patient and therefore is apt to go beyond the point of doing good, exciting muscle spasm and resulting



in loss of movement.

In the examination of an injury to any part of the upper limb, it is as well always to examine the shoulder and clavicle as a routine. It has been the lot of the author on several occasions to see patients who complained of trouble with the shoulder, previously unrecognized, after such an injury as a Colles' fracture.

Not only does it require a little explanation to the patient as to why this had not been noticed previously, but it also entails a very painful course of treatment for the patient to undergo before full function is restored. And should the patient happen to be of a certain age such restoration of function may never be absolute. Whilst movement in this joint may be comparatively easy to maintain should injury be recognized promptly and adequately treated, discovered several weeks afterwards it presents quite a different problem. It now requires a plucky patient and a painstaking attendant to deal with the situation.

Though simple falls on the shoulder or strains of this joint are apt to be treated lightly both by the patient and his medical attendant, they are responsible for more loss of function than many fractures. It is as well to point out that from the patient's point of view it is often limitation of the extremes of movement, i.e. the last few degrees in each direction which are responsible for the most persistent symptoms. The majority of instances of "so-called neuritis" following injury of the shoulder with pain referred down the outer side of the arm to the elbow joint and even the hand are entirely due to limitation of the extremes of movement and are not neuritis at all. This so-called neuritis clearing up at once when restoration in the movement of the shoulder joint has taken place. Besides examining movement, the presence of any effusion into the joint may be determined by swelling and tenderness on its anterior aspect.

Prevention of disability through loss of movement

should be our aim and not its cure when established. Whilst fractures in the region of this joint of course require treating, in doing so the other trouble which may arise should not be lost sight of. As in all other joints a traumatic synovitis of the shoulder joint requires a period of rest to aid in the absorption of the fluid but never a period of complete immobilization. Unlike other joints it is by reason of its structure particularly liable to get stiff. It has a voluminous capsule between whose surfaces adhesions form with the greatest of ease. The duration and degree of rest given must of necessity depend upon the severity of the injury, the degree of pain that results and the damage to the structures around the joint.

Pain may be relieved by hot bathing, radiant heat or antiphlogistine combined with gentle massage to relieve muscle spasm. In the intervals all that is necessary is the provision of a sling to support the weight of the arm. Active movements must be encouraged at the earliest possible moment.

After any injury to a joint the patient very rapidly loses the power to contract his muscles voluntarily. This is very obvious in the knee-joint and it is equally apparent in the shoulder-joint. The patient very often will appear quite unable to contract the deltoid, and in order to get over this difficulty the patient should be treated in the early stages in the recumbent position. The first thing that is necessary is to support the upper limb, for the patient without assistance is helpless, and unable to carry out any movement, let alone that against gravity. Whilst support is being given to the limb the patient may be deceived into using his muscles. The arm is gently abducted about  $30^{\circ}$  from the side and the patient then instructed to press upon the arm of the masseuse, in doing which he unconsciously puts into action all his shoulder muscles including the deltoid, and at the same time the arm can be further abducted by the

masseuse offering a resistance without exciting muscle spasm or causing pain.

In this manner a very considerable range of movement is obtained, whilst simply asking the patient to move the joint on his own initiative is certain to result in failure. Having once persuaded the patient that voluntary movement, of however small a degree, can be carried out half the battle is won. It then consists of a process of encouraging the patient. There is just one very practical point to remember. The time when the patient gets most pain in this movement is not when the arm is being abducted so much as when it is being replaced at the side. For this reason the patient must himself adduct the arm whilst it is still being supported.

The personality of the masseuse treating the patient is all important; she must be able to impose her will on him with each advance encouraging to greater achievements. It is useless, in fact it is laying the seeds for future trouble, to massage the shoulder. Massage will relieve spasm and improve the circulation, but active movement by the patient is the only means of bringing about a restoration of function. This cannot be emphasized too strongly. And this is the problem with which we have to cope in one form or another after all injuries of the shoulder. Once the joint has been allowed to get stiff the problem is essentially different. Very often the patient himself does not appreciate that there is this lack of movement in the joint, for by means of scapula movement he is able to do most things and what he complains of is loss of power and neuritis. When such a condition is present before any progress can be made the adhesions which have formed and are mainly responsible for the loss of movement must be ruptured. It is probable also that the head of the humerus becomes stuck down to the glenoid ligament in addition.

Under full anæsthesia the joint is freed by

manipulation. Manipulation consists of putting the joint once through its full range in each direction and having obtained full range leaving it alone. It does not consist of moving the humerus like a pump handle nor does it require great strength. The danger of fracturing the humerus is not very great if the humerus is taken hold of close up near the head, and then only in old people or if the joint has been stiff for a long time.

Manipulation alone is useless. It is only the start of treatment and requires following up with heat, massage, and active exercise as already described.

It is advisable with certain patients to provide them with a light abduction splint to hold the arm abducted to  $90^{\circ}$  to obviate the danger of adhesions forming again, but as a routine this is not necessary. It is at the best an uncomfortable instrument and requires continuous adjustment. The ready co-operation of the patient is essential to the success of manipulation. They have to go through a considerable amount of pain before they receive their reward, and it is always advisable to prepare them beforehand with this knowledge, holding out to them a confident prediction of success in the final instance.

Lest the surgeon who manipulates one of these joints should be disappointed a few days afterwards when on examination he discovers that the joint has got stiff again, it is as well to remember that the humerus often appears to get stuck to the glenoid but at the new angle. This need occasion no anxiety, such stiffness always entirely clears up if full range has been attained at the time of manipulation. The movement, which it is most difficult to obtain full range of, is internal rotation. It requires a lot of hard work on the part of everyone, and in older patients is probably always slightly deficient.

It is commonly taught that after a simple synovitis of the shoulder full range can be obtained in three to

four weeks. This is not the experience of the author. It often takes as long as three months before the patient can use in a normal manner the affected joint, and is free from any kind of discomfort. When manipulation is necessary to free the joint, treatment requires continuing even longer, especially in a sensitive patient.

#### FRACTURES

*The clavicle.*—The most common fracture involving the shoulder girdle is that of the clavicle in its middle third. In common with all other fractures its successful treatment depends upon a satisfactory reduction of the displacement. If only slight there is no difficulty, but otherwise if grossly displaced an anæsthetic is necessary. The routine method of fixation should be that of the three-handkerchief method. It is simple, easy to apply, the patient is comfortable and can move the hand in the sling at once. At the end of a few days with the patient recumbent the shoulder can be moved and after a fortnight only a sling is required to take the weight of the arm. With strapping, movement is restricted, the patient is uncomfortable and therefore Sayre's method should be abandoned.

Except for cosmetic effects it is unnecessary to confine the patient to bed. Even in a woman this is only desirable after gross displacement to prevent the formation of a large amount of callus. After all fractures of the clavicle there is a little bony swelling at the site, but in a very short time this gets moulded down and is not apparent.

Fracture of the inner end of the clavicle is rare and requires no special treatment, whilst that of the outer end occurs only a little less rarely. Displacement, if any, is slight, and the only treatment called for is the provision of a sling until symptoms have subsided, with such physical treatment as is wanted to relieve pain and swelling.

*Surgical neck of the humerus.*—After a fracture of

the middle third of the clavicle this is the really only common fracture. It may be simple or comminuted, in the latter instance being associated very often with a fracture of the great tuberosity. Fortunately in the majority of accidents it is impacted, and if not already so in a very few days the fractured surfaces become stuck together so firmly that for practical purposes it becomes as good as impacted.

Always associated with a considerable amount of swelling, hæmorrhage and muscle spasm, the necessary elements which go to the production of a stiff shoulder are present. After a skiagram of the injured part has been taken and a decision has been made as to whether any displacement requires correction, the immediate treatment should be directed to relieving the symptoms, chiefly the muscle spasm which is painful. Quite often it is not realized what relief the patient gets when this is done. Heat in some form with gentle stroking massage is certain to increase very rapidly the comfort of the patient and often will enable him to sleep in comparative comfort even on the first night.

With regard to splintage or fixation, as has already been pointed out, an abduction splint is not free from disadvantages, and in the treatment of this fracture is not always desirable. An ordinary sling taking the weight of the arm in most instances is all that is called for. The patient does not need to be confined to bed, and at night prefers to lie propped up in bed with pillows rather than to lie in the prone position.

In those injuries in which the fracture is impacted movement carried out in the recumbent position may start almost at once, whilst in an unimpacted one it should not be delayed more than a few days. By this time the fracture has got sufficiently firm to be safe to move. Treatment now is followed out in exactly the same manner as described for injuries of the shoulder not associated with a fracture.

A very guarded prognosis should be given as to the length of time before full function returns. It often takes two or three months, or even longer.

*Fracture of the great tuberosity.*—This is not a very common injury, and more often than not is associated with some other lesion. Unless grossly displaced a sling with early movement is all that is necessary. If not very much out of position at the time of the accident it is unlikely later to become so. When there is much displacement the tuberosity, if not replaced, may remain painful and hinder subsequent abduction by impinging against the under surface of the acromion.

Manipulation under an anæsthetic with fixation upon an abduction splint may be all that is necessary to reduce and keep it in position. Otherwise the most satisfactory form of treatment is to expose the fracture, and unless it is comminuted, to fix it in place with a beef bone peg. Should it be badly comminuted the wisest thing is to remove the fragments, and if it is decided to perform an open operation there is no advantage in delaying this. It is much easier to do this at once before it has become friable and apt to split up into pieces when the peg is driven through it. Early operation has the added advantage of allowing the exit of extravasated blood before it has had time to start forming adhesions.

*Fracture dislocation of the shoulder.*—This is a serious but fortunately a rare accident, the head of the humerus being dislocated into the sub-coracoid position and the humerus fractured with gross displacement of the shaft inwards. A necessary complication of this injury is that there is considerable damage to the joint capsule, tearing of muscle tissue, whilst vessels and nerves are more liable to suffer injury than in other fractures.

Treatment in the first instance consists in attempting reduction of the displacement by manipulation under an anæsthetic. Should this fail the condition must

be tackled by open operation. The joint is exposed through an anterior incision, and the upper end of the shaft which is entangled in muscle tissue is cleared freely, and the head of the humerus identified. As much blood clot as possible is cleared out and then an attempt is made to impact the shaft of the humerus into the head, thereby providing a lever which may be used to reduce the dislocation. It may fail, in which case the head, which is always difficult to control, will have to be reduced alone and the fractured surfaces subsequently placed in contact. The head of the humerus should never be excised unless it is comminuted or repeated attempts at reduction fail, the subsequent functional result being better if it can be retained.

Fixation upon an abduction splint is desirable at the time of operation, and when the stitches are removed regular physical treatment is necessary to aid in restoration of function. Movement after this accident is always very considerably limited.

The other fractures of the scapula, those of the body, the neck, or the glenoid are rare. The two former only require the scapula strapping to the chest to prevent painful movement. Fracture of the glenoid by virtue of direct involvement of the shoulder joint is probably better treated at the start on an abduction splint, the period during which a patient requires to wear such a splint being controlled by the symptoms.

#### DISLOCATIONS

*Dislocations of the shoulder.*—This is the most common example of any dislocation. Usually it occurs without any other injury complicating the issue. In a straightforward anterior dislocation there should be little difficulty in its reduction. It generally almost reduces itself. Simple external rotation of the arm, raising forwards at the same time the point of the elbow, if carried out gradually paves the



way to an easy reduction. Great force is unnecessary and also not desirable. After reduction a sling to take the weight of the arm, with heat and gentle massage to relieve any muscle spasm is desirable. As soon as possible active movements should commence. It is not necessary to keep the arm to the side. It is very doubtful if the capsule is torn in the ordinary simple dislocation, and certainly the head of the humerus is not kept in its place by the capsule, the muscles of the shoulder carrying out this function.

In young adults a dislocation of the shoulder gives rise to little trouble, but in older subjects it is a troublesome accident. They take a long time to get over the effects, and nearly always have some permanent limitation of movement.

The undiscovered dislocation is fortunately rare and most often is seen in old people, quite often through their not having taken the trouble to seek advice. Considerable care is desirable in these old dislocations lest the humerus be fractured. Before attempting reduction of such a joint the arm requires pulling away from the side to stretch the soft tissues and then reduction may be tried. Up to about three weeks success should follow this routine, but later it becomes increasingly difficult. In really old subjects it is probably better to leave a late dislocation unreduced and restore their function as much as possible without doing anything further.

Recurrent dislocation of the shoulder occurs in healthy adults with good muscular development. The slightest accident or even abduction of the arm being sufficient cause for the joint to go out. Likewise the reduction is almost as easy. Weakness of muscle power is not the cause of this recurrence and retentive apparatus is of little, if any, value in its treatment, and to produce a permanent cure the condition must be tackled by operation.

*Dislocations of the clavicle.*—The two dislocations

of the clavicle are those which occur at the sternal end or at the acromio-clavicular joint. The former, comparatively rare, is nearly always forward. Seldom complete it is easily reduced and just as easily comes out again. Retention by strapping does little good and the condition usually remains permanent. The dislocation at the acromio-clavicular joint is quite common, being seen principally in the hunting field or on the football field. The clavicle is dislocated upwards and forms a prominence with tenderness and some swelling. It may be displaced only a little or almost completely. A good sling in minor displacements is all that is necessary, otherwise some form of apparatus approximating the point of the elbow to the acromio-clavicular joint must be worn until the condition is consolidated. There is always some permanent prominence left, but operation seldom needs consideration as the disability is negligible.

To reiterate, the whole course of our treatment of injuries of the shoulder should be coloured by our desire to prevent stiffness and to obtain full range of movement in every direction. In some patients, no matter how diligent we are, a certain limitation results and then manipulation is called for. There is a time to do this, and if done prematurely diminution of range rather than increased function will result.

# Some Common Fractures of the Upper Extremity

By E. LAMING EVANS, C.B.E., M.A., M.D., F.R.C.S.

*Senior Surgeon to the Royal National Orthopædic Hospital;  
Orthopædic Surgeon to the West End Hospital for Nervous Diseases,  
and King Edward Hospital, Ealing.*

**L**OCAL *anæsthesia*.—A distinct advance has been made within the last year or so by the use of local analgesia in the treatment of fractures. But the method employed is still far from being universally known and accepted; indeed, I can find no reference to it in Wilson's "Fractures and their Complications," published so recently as 1931, and emanating from Toronto. The principle differs from the well-tried infiltration anæsthesia when all the tissues must be infiltrated with the anæsthetizing solution. In the case of a fracture, all that is necessary is to inject the fluid into the traumatic sac caused by and containing the fractured ends, and the fluid will come in contact not only with the bone ends but with all the soft tissues, muscles, tendons and ligaments which have been ruptured or separated by the fracturing force. Such a traumatic sac becomes filled with blood, which is often described as a hæmatoma, and the blood diffuses the analgesic fluid, not only to the ends of the bones, but to all the damaged soft tissues. In this way all painful sensations are abolished and muscular spasm, which is set up by contact of rough bone on traumatized soft tissues, is inhibited. Coagulation of blood and the formation of fibrinous deposits within the traumatic sac will prevent access of the analgesic fluid to the damaged parts: hence the method is applicable only in recent fractures. If local analgesia is employed in older cases both ends of the bones must

be infiltrated. If two bones are fractured, or one bone is fractured in two places, each of the traumatic sacs must be injected. Two per cent. solution of novocain is employed and up to 60 c.cm. may be used without toxic symptoms: the amount will depend upon the size of the sac. A 10 c.cm. record syringe is used with a short needle. The needle is directed obliquely towards one of the fractured surfaces. A few c.cm. of solution are injected and the syringe removed from the needle. If blood-stained fluid flows back along the needle then the needle has entered the sac and the injection can proceed. If the fluid is not blood-stained then the needle must be redirected until the hæmatoma is reached. The parts become analgesic within a few minutes of injection, when the reduction of the fractures can proceed. The analgesic effect lasts three to four hours. If X-ray examination after setting shows an imperfect reduction the sac may be injected a second time. Local anæsthesia is particularly applicable in cases of fracture of the arm when the patient has to be sent home in a public conveyance.

*Clavicle.*—The usual site is at the junction of the two curves, about the middle of the shaft. The outer fragment is depressed by the weight of the shoulder and upper extremity, and displaced inwards by the pull of the adductors in front and behind. Reduction is effected by elevation of the shoulder and a longitudinal pull upon the clavicle: this pull can be obtained by placing the fist in the axilla as the fulcrum of a lever and adducting the elbow to the side. A hundred different methods of fixation have been described; the one with which the practitioner is most familiar will probably give him the best results, if he bears in mind the necessity to maintain elevation and a longitudinal pull by an axillary pad.

A perfect anatomical cure is very rarely obtained by the ambulatory method but the functional result is good. If an anatomical cure is required, as in the case

of a woman, she should be treated by recumbency in bed for seventeen to twenty-one days with a small flat pillow between the shoulders and no pillow under the head. Reduction is rendered easier by the use of local anæsthesia and, as the clavicle is subcutaneous throughout its length, the injection is very simple.

*Fracture of the surgical neck of the humerus.*—This is a common fracture, and results directly from a fall or blow on the shoulder or, indirectly, from a fall on the outstretched hand or elbow. It may be impacted without gross deformity, when the impaction should be preserved: if gross deformity is present the impaction should be broken down. The upper fragment is abducted and externally rotated, the lower fragment is adducted, internally rotated and displaced inwards and upwards. To reduce, the lower fragment must be externally rotated and traction made upon it in the same direction as that in which the abducted upper fragment lies: the ends will then usually snap into position. The tendon of the biceps frequently lies between the fragments, but is freed by external rotation and a correctly aligned traction. After reduction there is little tendency to displacement if the arm is fixed in abduction and external rotation. The possibility of two serious complications should be remembered in examining every case of fracture of the surgical neck: (1) dislocation of the head of the humerus from the glenoid; (2) fracture and separation of the great tuberosity of the humerus. If the head is dislocated an attempt should be made to reduce it at once by manipulation under general anæsthesia, aided by long axis traction of the limb in the abducted position. If this fails the joint must be opened and the head levered into the glenoid. If, for any reason, the patient refuses this treatment the position should be carefully explained in the presence of a reliable witness.

If the great tuberosity of the humerus is displaced so as to lie directly under the acromion, and unites in

this position, abduction of the arm will be greatly impeded or altogether lost. It is then necessary to expose the site of fracture and to fix the tuberosity to the neck, either by catgut sutures or by beef bone pegs. In lesser degrees of displacement, union in good position will follow if the arm is sufficiently abducted.

*Supra-condylar fractures.*—This is a common fracture in childhood and its improper treatment may lead not only to a curtailment of movement at the elbow joint, but to that most dreaded of all complications, Volkmann's ischæmic paralysis. The fracture occurs from a fall on to the outstretched hand with the elbow in full extension. The fall is often a trivial one and may mislead the parent who delays seeking advice until the swelling makes a diagnosis uncertain without X-ray examination. The usual line of fracture is oblique from above downwards and forwards, and the lower fragment is displaced upwards and outwards behind the upper fragment. The prominent lower end of the upper fragment may press upon the brachial artery, the median and radial nerves. A complete reduction is essential if the risks of complications are to be avoided. Though it must be confessed that growth in childhood will round off many angulations, and that some ill-set fractures result in perfect function, yet the onset of ischæmic paralysis is so sudden and dramatic, the result is so sure, and the causation so certainly associated with incomplete reduction, that it is essential to strive for the completest reduction and the maintenance of the reposition during healing. A general anæsthetic is advised for reduction so as to eliminate the element of fear in childhood. Long axis traction is made upon the extended forearm, with counter-traction by an assistant upon the arm. After the fragments have been drawn apart simultaneous movement of hyper-extension of the lower fragment through the elbow joint and a backward pressure of the lower end of the upper fragment effect reduction, which is

only retained by flexing the forearm through about  $40^{\circ}$  upon the arm, on account of the obliquity of the line of fracture. When, formerly, a right-angled position was employed in treating these fractures, retention of the reduction failed and the movement of flexion was reduced owing to the upper fragment slipping forward, and was often never regained. By the use of the acutely flexed positions the movement of full flexion is the usual result. The forearm should never be fixed in such an acute angle of flexion as to interfere with arterial or venous circulation, as this will lead to ischæmic paralysis. But the surest way to avoid this calamity is by complete reduction of the fragments and retention of that reduction by flexing the forearm through  $40^{\circ}$  or the nearest angle to this that the circulation will allow.

*Fracture of the external condyle.*—This is a common injury in childhood and equals in frequency supra-condylar fractures. It is caused by falls on to the outstretched hand and may be accompanied by a fracture of the radius. Force transmitted from the hand passes through the wrist to the radius and to the capitellum: the ulna, not entering into the wrist joint, does not transmit any force, hence the infrequency of fractures of the internal condyle. The line of fracture runs from the outer edge of the trochlea to the external supra-condylar ridge and the fragment carries the capitellum. In adults the displacement is lateral and the fragment can easily be manipulated into position and retained by flexion of the elbow. In children, however, the fragment commonly rotates right round so that the fractured surface looks outwards and the whole fragment is displaced downwards. The fragment may rotate on a transverse axis also. Manipulation to reduce should be tried, but only too frequently it fails. An open operation is then imperative, when the fragment can usually be fixed by catgut sutures and the retention consolidated by  $40^{\circ}$  forearm

flexion. If the fragment is left unreduced, much limitation of flexion and extension occur, and removal is indicated, as suture of the fragment to the shaft in old standing cases is impossible. Following removal or malunion in children cubitus valgus is liable to develop, involving the risk of late ulnar nerve paralysis. This is caused by continuous stretching of the ulnar nerve in its groove behind the humerus: the symptoms may be delayed many years after the development of the cubitus valgus. Fortunately transplantation of the nerve to the front of the joint is almost invariably successful.

*Fracture of the olecranon* is a common injury caused by direct trauma or by violent muscular action. Separation depends upon the laceration of the soft tissues. If it is slight, and reduction can be easily effected, the fragment can be anchored to the ulna by pad and strapping. But if the bony surfaces cannot be felt to grate upon each other when reduction is attempted, a thick sheet of aponeurosis is lying between the fragments, and any union which may occur under these circumstances will certainly suffer subsequent stretching and loss of extensor function. In these cases the joint should be opened, all blood clot removed and the aponeurosis dealt with by removal or replacement. Occasionally the fractured ends can be held together by suture of the soft parts, but it is usually necessary to drill the fragments and fix by piano wire. If the skin is damaged at the time of injury a delay of a week or ten days does not add to the difficulty of the operation. There is usually only slight tension on the wire so that the elbow can be fixed in 90° flexion after the operation. Results are good.

*Fractures of the shafts of the radius and ulna, with overlap.*—These are common and troublesome cases. Besides the longitudinal displacement of both bones, the ulna usually angulates backwards and the radius



forwards, whilst the distal fragment of the radius is drawn towards the ulna by the pronator quadratus and is pronated. The proximal fragment of the radius is usually supinated by the biceps, even when the fracture is below the insertion of the pronator radii teres, because the supinating force of the biceps is greater than the pronating force of the pronator radii teres. These displacements of the ends of the radius, supination of the upper and pronation of the lower determine the position of full supination of the lower fragment if the fractured surfaces of the radius are to lie in apposition.

An attempt should be made to reduce the overlap by strong longitudinal traction, an assistant making counter traction upon the arm: the hand should be held in full supination and digital manipulation used to bring the ends in apposition: general or local anæsthesia must be used. The result should be checked by X-ray films in two planes. Reduction by traction and manipulation is notoriously difficult. If the overlap is left unreduced union will occur, but the resulting range of supination and pronation will be reduced, and the loss compensated by rotation at the shoulder joint.

If the overlap cannot be reduced, two methods may be employed: (1) *Continuous longitudinal traction* by means of a Thomas' arm splint, with the hand in supination. The result should be frequently checked by X-ray films and if, as not infrequently occurs, the overlap persists, recourse should be made to (2) *reduction by the open method*; both ends of the radius and ulna are exposed and, by leverage, brought into apposition. If the fractured ends are transverse the jaggedness of the surfaces will usually hold them in opposition, or they may be forcibly impacted. If the line of fracture is oblique a central bone peg or an absorbable suture should be employed. The use of metal plates is not recommended on account of the frequency

of non-union after their employment in this situation. Whatever splints are used two points should be carefully observed: (1) to see that the subcutaneous border of the ulna is kept straight and not allowed to angulate by sagging into the splint; (2) that neither splint nor bandage press upon the radius so as to diminish its natural outward convexity. Active movements of the fingers should be commenced at once; but of elbow, wrist and forearm only after about four weeks.

*Lower end of the radius.*—The commonest and most important fracture of the lower end of the radius is the Colles, in which the lower fragment, carrying with it the whole hand, is displaced dorsally and to the radial side. Separation of the lower epiphysis may occur up to the age of twenty-one, and the signs and treatment are similar to those of a Colles. The line of fracture is through the lower one inch of the radius, is transverse from side to side and oblique forwards and downwards from the dorsal to the volar surface. The articular surface of the radius is directed downwards, backwards and outwards. The fragments are commonly impacted. The styloid process of the ulna is detached or the internal lateral ligament of the wrist is torn.

The so-called “dinner fork” deformity renders the diagnosis easy. If this deformity is not present after a severe sprain of the wrist it is advisable in all cases to examine by X-rays, as a fracture with impaction without marked displacement or an oblique linear fracture into the joint as from a back-fire may be present and influence both the method and duration of treatment, and the prognosis.

As to the question of disimpaction, no hard and fast rule can be laid down. If the deformity is slight, the patient old and occupation light, the impaction may remain and treatment should be directed to keeping the fingers and wrists supple. All other cases should be disimpacted and treated by manipu-

lation, fixation and active exercises. A good rule is, if in doubt disimpact, because union in the corrected position is sure and rapid, and the return of function occurs in favourable conditions. Non-union is practically unknown: compare this with impaction of the neck of the femur in subcapital fractures; these should never be disimpacted in the aged for fear of non-union. The fragments must be disimpacted; in recent cases this can be done by tractions, flexions and manual pressure. In cases of long standing, a 'Thomas' wrench or wedge may be required, whilst later, an osteotome may be employed to separate the fragments along the line of impaction.

In recent cases the injection of 20 c.cm. of a two per cent. solution of novocain is a most satisfactory analgesic; a single injection into the traumatic sac from the dorsum will usually suffice, a second on the palmar aspect may be required. After reduction, the wrist should be volarflexed from  $45^{\circ}$  to  $60^{\circ}$  and fixed in this position by a single dorsal plaster slab\* applied directly over stockinette.

This flexed position should be maintained for six to eight days, when the fractured ends will have become "sticky" and a return to the mid-position of the wrist joint will not cause displacement. The flexed position of the wrist is indicated on account of the obliquity of the line of fracture; the dorsal tendons, being tense in flexion, prevent the lower fragment slipping upwards and backwards. The plaster casing aims at fixing the wrist in flexion rather than exerting any direct pressure upon the lower fragment. When the parts are analgesic, and after setting the fracture, it is well to make a second plaster splint by moulding a plaster folder to the palmar surface of the forearm

\* A plaster of Paris slab or folder is easily made from an ordinary plaster bandage five yards long and five inches wide. By folding the bandage in twelve inch lengths two folders are obtained each with seven thicknesses of muslin, which are strong enough and very light.

and hand in the neutral position : it will be used when the dorsal plaster is removed at the end of a week. Each of these plasters must be short enough to allow full flexion and extension of the thumb and fingers at all their joints. If these movements are commenced within twenty-four hours of the setting there is no danger of subsequent finger stiffness and massage can be dispensed with entirely. This treatment gives far better results and in a shorter time than when a movable splint is employed and the masseuse allowed to remove and replace the splint.

In conclusion, I cannot stress too strongly the importance of X-ray proof of reduction and retention in every fracture; of the dangerous futility of an X-ray in one plane only and of the disastrous financial situation which may arise from neglect of this sound surgical principle.

# Injuries of the Wrist

By R. WATSON JONES, B.Sc., M.Ch.Orth., F.R.C.S.

*Honorary Assistant Surgeon in charge of Orthopædic Department,  
Liverpool Royal Infirmary; Lecturer in Clinical Orthopædics and  
Orthopædic Pathology, Liverpool University.*

## FRACTURES OF THE LOWER END OF THE RADIUS

FIVE thousand years ago an Ancient Egyptian fractured the lower end of his radius. Gutter splints were made from strips of bark, padded with dried leaves and fibre, and only the untimely death of the patient from an unrelated cause has enabled Sir Arthur Keith to demonstrate in the Royal College of Surgeons Museum to-day, the method of immobilization in use fifty centuries ago. It stands as a reproach to modern civilization, that despite an apprenticeship of such amazing duration, Colles' fractures are still allowed to unite with deformity and with stiffness of the fingers. Yet it is easy to secure such cosmetic and functional perfection that it is impossible to determine clinically which wrist has been fractured, in at least 80 to 90 per cent. of cases. Three principles of treatment must be observed:—

(1) Manipulative reduction, controlled by immediate X-ray through the splints, and repeated as necessary until a perfect position is secured. (2) Complete and undisturbed immobilization for four weeks. (3) The institution on the first day of "functional treatment" including full movements of the fingers, elbow and shoulder.

*Manipulative reduction.*—The displacement of the distal fragment is in two directions: (a) a backward displacement, and tilt; (b) an outward, radial, displacement and tilt. Incomplete correction of the backward displacement impairs the functional result, because the altered axis of the wrist joint causes permanent

weakness of grip. Incomplete correction of the outward displacement impairs the cosmetic result, because the whole hand remains deviated to the radial side with resulting prominence of the lower end of the ulna. This ugly deformity is conspicuous if the uncorrected outward displacement is of no more than one or two millimetres.

In the manipulative manœuvre taught by Sir Robert Jones,<sup>1</sup> both displacements are simultaneously corrected by a pronation movement of the distal fragment which thrusts it forwards and inwards. Although perfectly effective in the hands of its author, in other hands this method frequently leaves the radial displacement incompletely corrected. Perfect reduction is secured with much more certainty, if the deformity is visualized in its two component parts, and each element separately corrected. In the case of a left 'Colles', the operator grips the distal fragment with his right hand, and with strong pressure over the back, it is pushed and tilted forwards. A new grip is now taken, and by equally strong pressure applied over the outer side of the distal fragment with the operator's left hand, it is pushed and tilted inwards. Spreading of the fragments in a comminuted fracture is corrected by compression between the operator's two hands, in both the antero-posterior and the lateral axes. Compression manipulation of this type, as opposed to leverage manipulation, is highly successful in replacing detached marginal fragments and restoring a smooth articular surface (Fig. 1A). The fact that a fracture of the lower end of the radius is comminuted is frequently claimed as an excuse for failure to reduce the displacement, and manipulation is said to be contra-indicated. Such teaching is retrograde and indefensible. If the fracture extends into the articular surface, the merest trace of uncorrected displacement will cause painful movement, grating and osteo-arthritis. On the other hand, if the

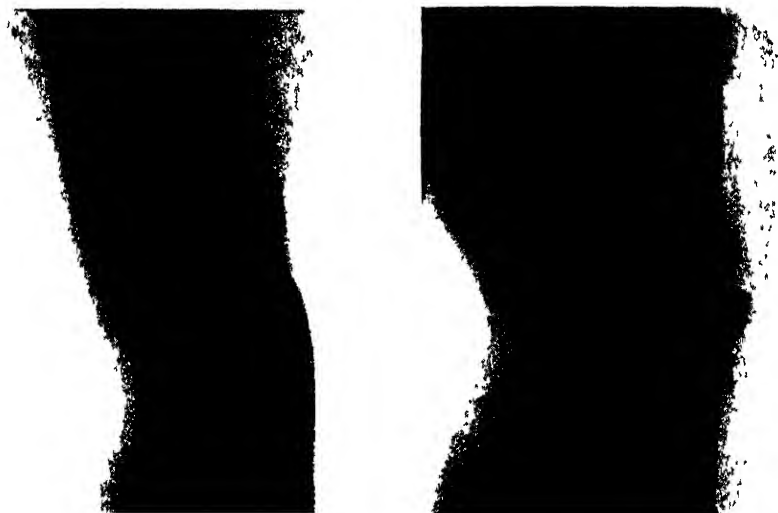


FIG. 1A. —Comminuted fracture lower end of radius, with inward and backward dislocation, complete detachment of radial styloid process, and breaking up of the articular surface with detachment of fragments.

articular surface is restored to perfection, a normal joint and limb can still be secured however many fracture lines extend into the joint. (Fig 1B.)

*Immobilization.*—Whatever means of immobilization is employed the fingers, thumb, and palm of the hand must be left absolutely free. If gutter splints are

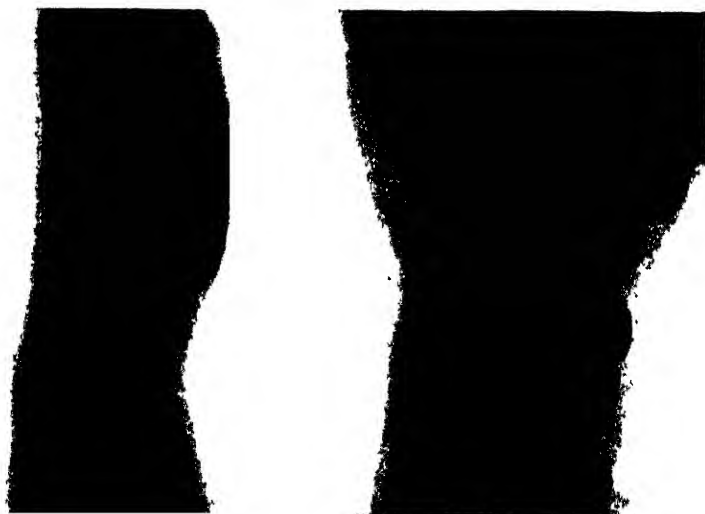


FIG. 1B.—Same case as Fig. 1A, after reduction by leverage and compression manipulation. Patient is a gymnastic instructress, and has resumed her original occupation with a wrist indistinguishable from normal.

used the dorsal splint must extend to the knuckles in order to prevent dorsiflexion movements of the hand, but the palmar splint must stop short of the thenar eminence. The use of a splint extending into the palm of the hand is not only unnecessary, but is dangerous. Atrophy of the thenar muscles, and stiffness of the fingers are inevitable, and frequently there will be recurrence of the backward tilt of the distal fragment. For these reasons, Carr's splint is a relic of the past, and in this enlightened age should never be used. A well-applied closely fitting (skin tight) plaster is an ideal means of immobilization, because a sling is unnecessary; the limb is put through the sleeve in the ordinary way, and the plaster being cut away from the palm of the hand, the arm may be used for eating, dressing, light housework, or carrying a stick or bag. Not only is the inconvenience of a fractured limb avoided, but such functional use prevents stiffness of joints, wasting of muscles and decalcification of bones. The plaster should be applied with the wrist in the neutral position and not in the fully flexed position of the Cotton-Loder method. In this position the fingers cannot be closed, and the recovery of wrist movement is delayed.

*Functional treatment.*—In the presence of infection or trauma, lymph is poured out into the subcutaneous spaces, and will organize and form adhesions. If under these conditions the metacarpo-phalangeal joints are immobilized in extension for so short a time as four weeks, the patient will never again flex his fingers fully, and a far more serious and intractable disability will arise than that caused by malunion of the fracture. The surgeon's responsibility lies not simply in leaving the joints unsplinted, but in stimulating the patient to move them fully in all directions, despite the swelling, œdema or discomfort which may be present during the first day or two. Movement, combined with elevation of the limb (if necessary on a frame),



will enable the swelling to subside very rapidly.

It is equally important that abduction of the arm to the side of the head, and rotation in each direction should be practised frequently from the first day, in order to avoid the very disabling stiffness of the shoulder which ten or fourteen days in a sling will produce, if the wrist fracture has been associated with slight and otherwise symptomless traumatic synovitis of the shoulder.

If in the treatment of a fractured wrist the surgeon sends a patient for massage and electrical treatment, he admits failure. The indications for physiotherapy are stiff joints, atrophied muscles, decalcified bones, and recurring oedema from impaired circulation. None of these complications should have been allowed to appear, and the only part that the masseuse can justifiably play in modern traumatic surgery is to direct and supervise the patient's own exercise, rigorously goading him into activity instead of lulling him to sleep with soothing massage.

#### MALUNITED COLLES' FRACTURE

Untreated Colles' fractures can still be reduced by manual manipulation until two or three weeks after the date of injury, and for a further few weeks there is still a possibility of securing full correction by using the Thomas' wrench.<sup>2</sup> In old cases, however, it is difficult to secure a perfect cosmetic result because the radial deviation can only be corrected with considerable difficulty, and it is then better to perform an osteotomy of the radius at the level of fracture, subsequently treating the case exactly as in recent injuries. By means of an osteotomy through a one-inch incision, deformities of ten or twenty years' duration can be corrected with complete success.

#### DISPLACED LOWER RADIAL EPIPHYSIS

During the first two decades of life, Colles' fracture

is rarely sustained, and the usual injury is a backward and outward displacement of the lower radial epiphysis with a flake of bone from the diaphysis. The type of displacement, clinical diagnosis and treatment differs in no respect from the corresponding injury of the adult.

In severe displacements the carpo-ulnar ligaments are torn and the epiphysis with the carpus and hand is widely displaced, leaving the ulna and the radial diaphysis in normal relationship. There is a second anatomical type which the author has described as "displacement of the radial diaphysis,"<sup>3</sup> in which the carpo-ulnar ligaments remain intact, and it is the inferior radio-ulnar group of ligaments which is torn. The ulna, radial epiphysis, carpus and hand now retain an undisturbed relationship and are all displaced backwards and outwards in relation to the radial diaphysis. If the injury is visualized as a forward and inward displacement of the radial diaphysis, the frequent complication of ulnar palsy by direct contusion is explained.

#### FRACTURE OF THE CARPAL SCAPHOID

Following a fall on the outstretched hand, or a backfire injury of the wrist, tenderness over the radial side of the joint immediately below the tip of the radial styloid must be regarded as evidence of a fracture of the scaphoid until it has been excluded by X-ray examination. Delay in establishing the diagnosis may mean all the difference between a wrist indistinguishable from normal and a weak painful arthritic joint incapacitating the patient from heavy work and from even the less energetic recreations of golf, tennis and badminton.

Until recently it was the exception to see a fracture of the scaphoid united by bone, and only a few years ago Thurstan Holland declared that he had never seen bony union after this injury. For many years

Sir Robert Jones has advocated prolonged fixation in dorsiflexion, and it has now been shown by Böhler that if this complete and prolonged fixation is combined with functional treatment sufficient to maintain free circulation and prevent atrophic changes, bony union can be secured in a large proportion of cases.<sup>4</sup>

As soon as the diagnosis is established the joint must be immobilized in 30° of dorsiflexion, but not by means of a cock-up splint, because if the palmar part of the splint is large enough to prevent lateral movements, it will interfere with the grip, prevent the patient from using the limb, and inevitably give rise to decalcification of the carpus which may inhibit union. A dorsal plaster cast is made by moulding a plaster slab directly on to the limb with no padding between. When completed it should extend from the upper forearm to the knuckles, and laterally it must reach the midline of the forearm and hand in order to prevent side-to-side movements of the wrist. Since the scaphoid is almost entirely intra-articular, union depends on the development between the two fragments of fine capillary vessels with osteoblasts, and there is no periosteal bone formation to assist in consolidation. The slightest shearing movement of the two fragments will rupture all the vessels, and if only repeated once in ten days will inhibit union. The cast must therefore fit very accurately and no movement is allowed until in about three months' time there is X-ray evidence of union.

Throughout this time, with the cast kept firmly in position with strapping and bandage, the limb must be used for all ordinary purposes. We have had patients who have continued their ordinary employment as housewives, motor drivers, schoolmasters and even ship's riveters. If the patient is willing to co-operate in this way, a wrist joint may be immobilized for 12 months, and the X-ray after that interval taken immediately the cast is removed will show no trace

of atrophic bone change.

#### UNUNITED FRACTURE OF THE SCAPHOID

The old operation of excising half or the whole of the scaphoid for non-union is practically obsolete. The operation has very little effect on the range of movement, it does not cure the pain, and it aggravates rather than relieves the tendency to osteo-arthritis.

On the other hand, the same treatment which is so successful in recent fractures, has a very beneficial influence in old fractures and in about 75 per cent. of cases bony union can be secured even two or three years after the fracture, if immobilization is continued for a sufficiently long period. Whereas in recent fractures union can be secured in two to three months, in old fractures with cavity formation the average time is six to twelve months. Serial X-rays taken at two-monthly intervals show gradual obliteration of the cavity, the wall of sclerosed bone adjoining the cavity absorbs, the density of the avascular half of the bone gradually approximates that of the remaining carpal bones and finally firm bony union is seen (Fig. 2). In old ununited fractures union can be considerably accelerated by multiple drilling of the fragments, either subcutaneously or through a half-inch incision over the tubercle of the scaphoid; this breaks up the wall of sclerosed bone and allows the more rapid development of blood vessels between the two fragments. After this simple operation, even in old cases, union may be secured in three or four months instead of six or twelve months.

#### DISLOCATION OF THE CARPAL SEMILUNAR BONE.

The semilunar is always dislocated forwards into the very confined space beneath the anterior annular ligament which is already fully occupied by the flexor tendons of the fingers and the median nerve. The typical clinical signs are, therefore: (a) immobility of the semiflexed fingers; (b) median palsy in 50 per

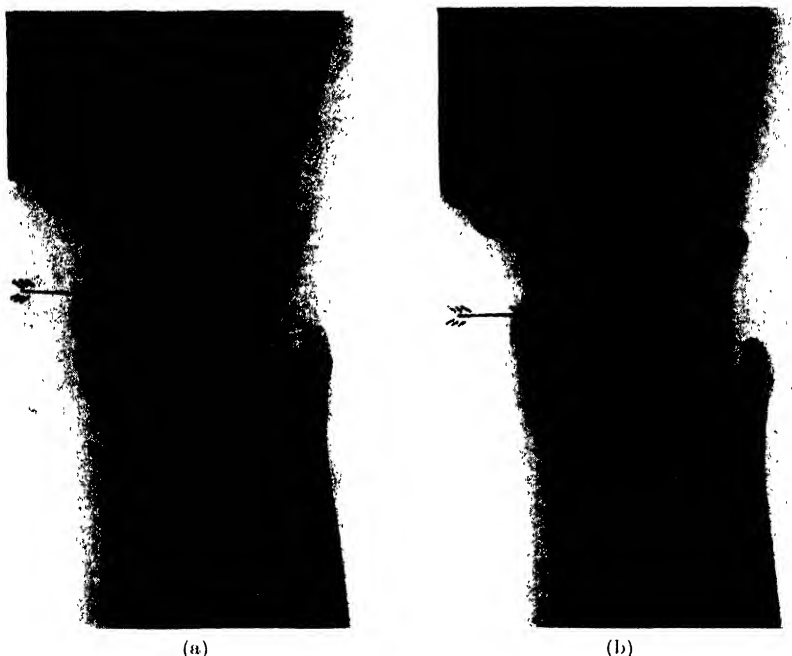


FIG. 2.—Ununited fracture of carpal scaphoid of nine months' duration. (a) before treatment, (b) after six months' treatment in a dorsal plaster cast. The wrist is now indistinguishable from normal. The patient still plays golf with a handicap of four.

cent. of cases; (c) swelling and painful limitation of wrist movement with no obvious deformity.

Until recent years the large majority of dislocated semilunar bones were excised. Although the results of this operation are better than would be expected, a normal range of movement and normal strength of grip is never restored. It is moreover quite easy to reduce the dislocation manually during the first fortnight and by open operation during the first few months.

In the method of manipulative reduction described by the writer,<sup>5</sup> the operator presses on the front of the semilunar with one thumb and applies traction to the remainder of the carpus with the other hand. Whilst maintaining strong traction the wrist is gradually flexed to the right-angled position (Fig. 3). In difficult cases an assistant should press over the front of the

bone with both thumbs and the operator concentrate on traction and flexion of the wrist. Reduction must be confirmed by immediate X-ray examination, and the wrist is then immobilized in  $30^{\circ}$  of palmar flexion for not more than seven days, by means of a dorsal plaster cast. A second cast with the wrist in slight dorsiflexion should be retained for a further ten days, and no further fixation is necessary. The wrist should be indistinguishable from normal within four to six

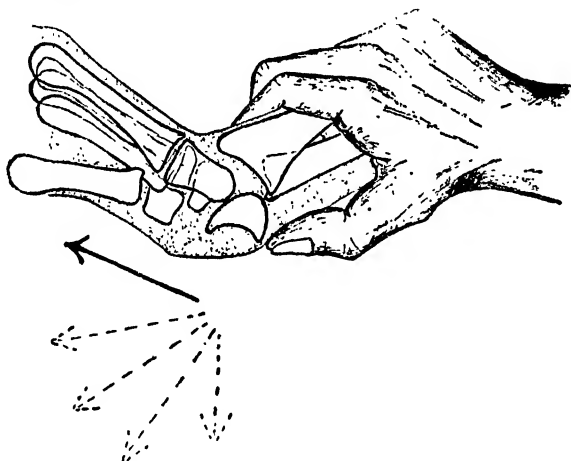


FIG. 3.—Author's method of manipulative reduction of dislocation of the semilunar. By avoiding the use of a wrench or wedge, the risk of injuring the median nerve is avoided.

weeks of the injury.

In cases of several weeks' duration where manipulation fails, the author has practised a method of operative reduction with successful results. Through a two-inch dorsal incision the head of the os magnum is freed by dissection and all adhesions of the carpus to the capsule freed. The same manipulation is now carried out, and the semilunar previously hidden from view, clicks up into position.

#### DISLOCATION OF THE SEMILUNAR WITH HALF OF THE SCAPHOID

Fracture of the waist of the scaphoid is not infrequently combined with dislocation of the semilunar

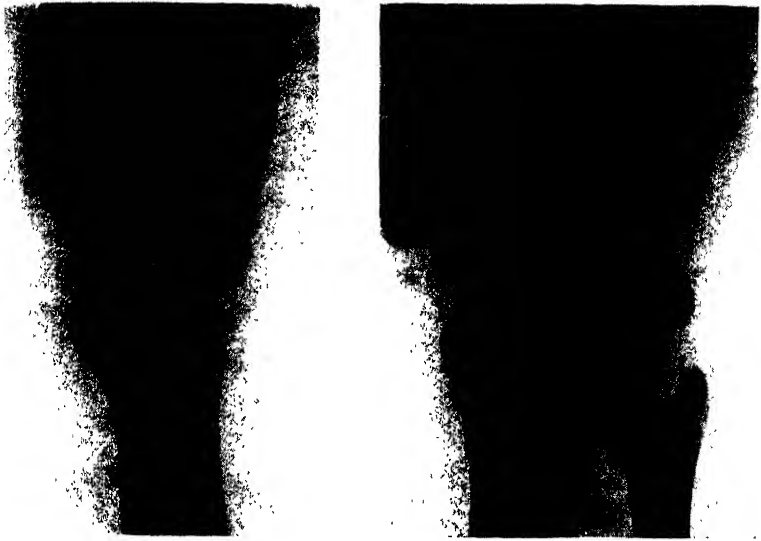


FIG. 4A.—Fracture of scaphoid with dislocation of semilunar and half scaphoid. Also comminuted fracture radial styloid process. (Note outward subluxation of the whole wrist, the distal half of the scaphoid impinging against the radial styloid.)

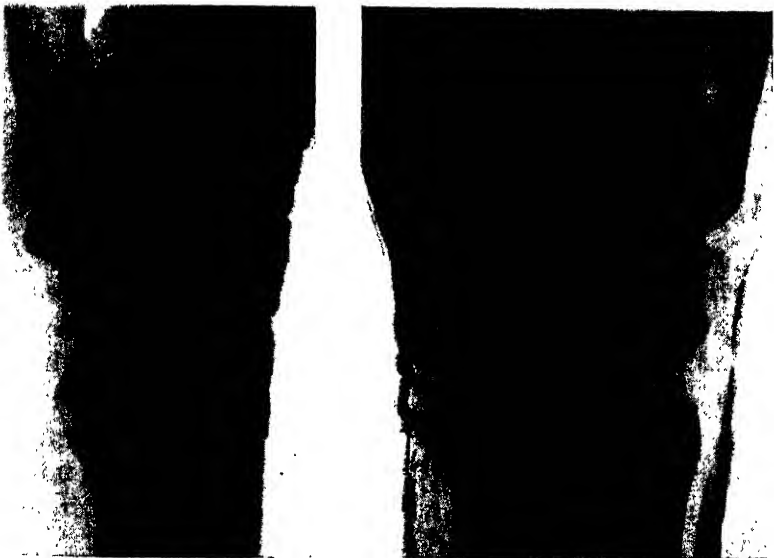


FIG. 4B.—Same case as Fig. 4A, after manipulative reduction of the dislocation (through plaster). The comminuted fracture of the radial styloid has been reduced by lateral compression of the wrist between the operator's two hands. A perfectly smooth articular surface has been restored.

which carries forwards with it the proximal half of the scaphoid (Fig. 4A). Excision of the semilunar and

half scaphoid causes a very severe disability because the remaining carpal bones are almost always subluxated to the radial side. The remaining half of the scaphoid impinges against the tip of the radial styloid process, movements are seriously limited, osteo-arthritic changes rapidly supervene and a bad cosmetic result is given by the radial deviation of the hand and the prominent lower end of the ulna.

The correct treatment is to reduce the displaced bones by manipulation (Fig. 4B) or by operation according to the duration of the injury, and then treat as for a fracture of the scaphoid, by prolonged immobilization in dorsiflexion combined with functional treatment. Perfect results can be secured.

#### References.

- <sup>1</sup> Jones, Robert : " Injuries to Joints," p. 110.
- <sup>2</sup> *Idem* : *Ibid.*, p. 115.
- <sup>3</sup> Jones, Watson : " Primary Nerve Lesions in Injuries of the Wrist and Elbow," *Journ. of Bone and Joint Surgery*, 1930, p. 133.
- <sup>4</sup> Böhler, Lorenz : " Treatment of Fractures," p. 98.
- <sup>5</sup> Jones, Watson : " Carpal Semilunar Dislocations," *Proc. Roy. Soc. Med.*, 1929, xxii, 1071.



# Injuries of the Hand

By R. R. KERR, M.B., F.R.C.S.

*Surgeon to the Victoria Memorial Jewish Hospital, Manchester ;  
Consulting Surgeon to the Cotton Spinners' Federation.*

TO all men whose livelihood depends upon the inherited or highly practised skill of their fingers—and they are many and of great variety, ranging from cotton spinners and surgeons to pickpockets and card-sharppers—a stiff forefinger or a tender scar in the pulp may be a much more serious matter than an acute appendix, and incidentally may need a greater degree of surgical skill for its satisfactory treatment. Before detailing specific injuries of this region, and the technique of the proper methods of dealing with them, there are certain fundamental principles to be appreciated.

The first point in setting about the treatment of an injured hand is to find out exactly what the patient has to do with it when it has recovered. As a general rule, in unskilled manual workers, the breadth of the hand must be preserved, and as much as is at all possible of the gripping power and of the spreading area of the fingers. In such cases, it is important to save any part of the finger, if a mobile, well-covered, and non-tender stump can be provided: but even in these cases, a stiff or tender stump is far worse than useless. In men who work among machinery, it is best to amputate a badly injured finger at once, as in these forms of work, even a partly stiff finger—which cannot be fully controlled, and cannot instinctively take care of itself—becomes a very real danger to its possessor. In most of the highly skilled manual workers, the breadth of the hand, and the number of fingers, is far less important than the dexterity and nimbleness of the remaining digits, and in these people,

the best results are obtained by amputating injured fingers, with the heads—and in many cases most of the shafts—of the corresponding metacarpal bones. In these cases, the metacarpal bone of each finger is simply a unit in a complicated lever, and when the useful part of the lever has been lost, there is no point in keeping the base, while its removal gives a much freer play to the remaining digits.

The fingers have very highly organized nervous systems, and septic inflammation in them sets up without any delay a neuritis, which is both progressive and intractable, so that it follows that the right time to amputate a finger which is so damaged that it will not recover sufficient function to help its owner in his work, is immediately after the accident. The very usual, and extremely human, tendency, to try and save such a finger, very often leads to an inflammatory infiltration of the hand and other fingers, and commonly ends in an unsatisfactory amputation, after the patient has endured months of painful treatment. The stump in these cases can seldom be well covered, and the neuritis persists indefinitely, causing weakness and great discomfort, and sometimes very disabling tenderness and hyperæsthesia. Besides all this, the pain from the inflamed nerves is extremely apt to interfere with the normal reflex control and co-ordination of the other fingers, leading to disabilities which are often classed as hysterical, but which in reality have a very real physical basis. Finally, most of the tragic results in these injuries—from tender scars to rapid death—are due to sepsis, and in particular to sepsis pent up in the depths of wounds which have been unwisely closed.

The immediate toilet of wounds in the hands and fingers consists in opening them up, washing them, and cutting away crushed and devitalized skin and other tissue. In all save the slightest cases, this should be done under a general anæsthetic. If there is the slightest risk of infection in the depths of the wound,

it is wiser and safer to leave it open, and dress with eusol or acriflavine. Clean incised wounds may safely be sutured after the use of acriflavine. Others may be very lightly drawn together. At this time also, very careful examination should be made for divided tendons, which should be reunited at once. In the hand and fingers, reunion of divided nerves is seldom possible or satisfactory. Fractured metacarpal bones and broken phalanges should be moulded into position under general anæsthesia, and set with a pad of wool in the palm, and the fingers well flexed over it. I put most of these cases into plaster of Paris for two weeks.

Where the presence of a division of tendons has been missed, or a primary suture has failed, an attempt should be made to reunite the ends at the very earliest feasible moment, which means as soon as active sepsis has subsided. These operations are often much easier than one would expect. The divided ends of the tendons are often, and indeed usually, not very far apart, and are not difficult to recognize. They are best sutured with fine silk, and afterwards the hand must be put in a position which relaxes the tension on the union to the greatest extent.

It goes without saying that where both flexor tendons to a finger have been divided, the very greatest care must be taken to unite the correct ends, and a glance at Cunningham's "Anatomy" is a help to this end. The extensor tendons are liable to several lesions peculiar to themselves. A sharp blow on the end of the finger may jar the tendon from its attachment to the end phalanx, causing the end phalanx to drop helplessly. The finger concerned should be splinted at once in the extended position for a month, and then mobility gradually restored by light active—never passive—movements. This nearly always gives a perfect result. If it does not, the tendon should be cut down upon, and stitched into place, the finger being again splinted for a month.

Over the back of the proximal interphalangeal joint, the extensor expansion is also apt to be torn, but in this position it splits longitudinally, the two sides slipping towards the palmar surface, and the finger is left helpless to a variable degree, as this injury is not often complete. The treatment here is to cut down and suture the tear at once.

Fingers that have become contracted into the palm following injuries may be straightened under anæsthesia, and put up in that position in plaster for a couple of months, with a fair chance of success, provided this is done before the bones and joints have altered anatomically. If the contracture returns, and seems to be due to a shortening of the flexor tendons, it is possible to lengthen these by a tendon-sliding operation, similar to that which is useful in the tendo Achillis. But to slide both the flexor tendons of a finger successfully is necessarily a very delicate operation.

All hand and finger wounds may become infected, but many of the most serious cases occur in wounds which are so minute as to be considered of no importance in the first instance. Pricks from pins and needles and from tiny wood or metal splinters in many forms of work are so common as to escape individual attention. The first sign that such a minute lesion is going to lead to trouble is aching and throbbing in the infected area, followed occasionally by rapid streptococcal cellulitis, but much more usually by the development of a localized inflammation in the affected digit. Most of these injuries occur under the nail, or in and around the pulp. The nail should be removed, and the inflamed area lanced, as soon as ever the trouble begins to manifest itself. If the sepsis spreads in the end of the finger, the bone of the end phalanx is very likely to become involved. If the end phalanx of a finger remains swollen and septic for two weeks, it may be taken for granted that the bone

is involved, and will necrose. The sequestrum usually involves the distal two-thirds of the phalanx, the basal third and with it the tendon attachments and the terminal interphalangeal joint remaining unaffected—and if the finger is freely incised, and the sequestrum removed as soon as possible, these structures usually escape altogether.

As soon as there is the faintest sign of involvement of the flexor sheaths, however (shown by tenderness on pressing over them), they should be opened. Septic infection in the fingers is not a desperately serious matter, so long as the tendons survive. They receive their blood supply from the vessels in the very delicate synovial ligaments called *vincula accessoria*. The effect of an acute septic inflammation in the closed tubes in which the tendons run, is to raise the tension immediately, and the vessels are literally choked by the pressure of the inflammatory products. Once this happens, death of the tendons concerned is certain. Therefore, the free opening of the tendon sheaths must be done early.

I saw a case some time ago in which a little finger had been injured, and had become extremely septic. The whole digit was swollen and very inflamed. This condition had been going on for over a week, but the tendons of the finger were still intact, and all the movements present. The explanation was that a small punctured wound had occurred in the palm at the same time, and opened the tendon sheath high up. From this small wound, pus was exuding in quantity, and it had undoubtedly acted as a safety valve, and saved the vitality of the tendons.

*Site of incisions.*—Incisions into the end phalanx of a digit should be made in the first place just to the side of the nail. If necessary, they may be made in this position on both sides, and they may even be joined across the tip of the finger, just in front of the nail. *They should never in any circumstances be made in the tissue of the pulp.* If they are, the tactile function of the pulp will be impaired, and a tender scar—which may be very intractable and disabling—is sure to result.

The incisions to open the flexor sheath of a finger should be made along the sides, well in front of the mid-line, and care must be taken not to divide the bands over the flexures of the joints, or prolapse of the tendons will occur. Inflammation is apt to spread from the flexor sheaths along the sheaths of the lumbrical muscles, and this should be watched for, and when it occurs, opened from the back of the web.

In the case of the thumb and little finger, sepsis has a free passage into the lower part of the forearm; in the other fingers, it is arrested where the sheaths end, about a finger's breadth in the palm. Inflammation in the palm should be incised along the lines of the metacarpal bones.

It is well to note that a suppuration in the palm causes a great deal of cedematous swelling in the soft tissues of the dorsum, but this should not be incised. When the suppuration has reached the lower part of the forearm, it should be relieved by incision on one or both sides, just above the wrist, and the point of a pair of dressing forceps passed inwards behind the tendons (Hilton's method). Here again, the incision should never be made in front of the wrist or down the middle of the forearm, or crippling adhesions and contracted scars will result.

*Amputations.*—All plastic operations on the hand, and all amputations, require the use of a tourniquet. In amputating phalanges, it is very important to obtain the covering from the fleshy tissue on the front of the digits. In the case of the end phalanges, it must be remembered that the nail bed goes back at least to the level of the end joint, and the tissues on the dorsum should be removed to beyond that point, or small nail remnants will continue to appear. Both flexor and extensor tendons should be looked for, and stitched in position.

In amputating a finger, in skilled workers, the head at least of the metacarpal bone should be removed.

I divide this bone by a metacarpal saw. The tendons running to the finger should be isolated, pulled well down, and divided as high up as possible. The portion of the flexor tendon sheath which lies in the palm is full of nerves, and if it has been inflamed, it will remain permanently tender. Therefore, it should be carefully dissected out. Both digital nerves should be found, pulled down, and divided at least three-quarters of an inch above the level of the amputation. They are quite easy to find, lying on the sides of the finger, slightly towards the palm, and the guide to them is the small artery which runs with them, and which is easily found. It is important not to damage the interosseous or lumbrical muscles more than necessary. A minor advantage of the removal of part of the metacarpal bone, particularly in girls, is that it leads to a very much better looking hand than an amputation at the metacarpo-phalangeal joint.

In conclusion, I should like to stress the very great advantage of metacarpal amputations; the necessity for dissecting out the digital nerves and finger tendons; and the usefulness of general anæsthesia, and of a tourniquet, in dealing with these conditions; but very particularly would I caution against the incising of the pulp and not the sides of fingers.

# Fractures of the Pelvis

BY SIR WILLIAM I. DE C. WHEELER, M.D., PAST PRES., R.C.S.I.,  
HON. F.A.C.S., HON. M.CH.

*Visiting Surgeon to Mercer's Hospital, Dublin.*

IN the study of fracture of the pelvis the views of the older writers will be found instructive and fascinating. During such literary excavations we come across some useless debris, but not infrequently the labour is rewarded by the discovery of nuggets of pure gold. Malgaigne and others conveyed the impression that extensive fractures of the pelvis were rare, and that recovery seldom followed. Both statements require revision. Fractures of the pelvis have increased in frequency with the development of industrial machinery and rapid transport. The crushing injuries associated with accidents to motor cars, aeroplanes, and the modern factory, supply us in bulk with this morbid material. Nor is the prognosis bad. Injuries contemplated with awe by our predecessors are treated with success by modern methods.

Although fractures of the pelvis usually follow severe violence, it is well to remember that some cases of extensive injury come with a history of only slight trauma. Long before the days of X-rays it was pointed out by such authorities as Dupuytren, Hamilton, Pott and Cooper, Erichson and Bennett, that no portion of the pelvis is immune from fracture.

In the wards of Mercer's Hospital, Dublin, and in private practice, I have seen fractures of the pelvic girdle, of the ilium, of the pubis, of the acetabulum, sacrum and coccyx, some of them many times. I have not seen a case of isolated fracture of the ischium, but Wakeley<sup>1</sup> mentions five in a series of 100 cases.

*Fracture of the pelvic girdle.*—These fractures result either from severe crushing injuries, or a direct fall. In the hunting field, the rider is thrown from a horse



and the horse rolls on him; in the street, the victim is run over by the wheel of a motor car or bus. The anterior portion of the pelvic arch breaks, and posteriorly, there is either dislocation of the sacro-iliac joint or fracture of the ilium vertically downwards from the crest to the great sciatic notch. Alternatively, the sacrum may give way. The fracture in front is most often on one side, and the fracture behind on the opposite. In some cases both ilium and sacrum are involved posteriorly, the line of fracture passing through the ilium near the upper angle of the sacro-ilia joint, and then downwards on the medial side of the joint through the lateral part of the sacrum.

Again, the fractures in front and behind may be limited to one side only. This variety is comparatively uncommon. When the pelvis is broken in front and behind, the bone and the attached lower extremity are connected with the rest of the body only by the soft parts which unite the pelvis to the spinal column and trunk. These soft parts are often stretched or lacerated.

Injuries of such severity are easily diagnosed. I know of no cases in surgery which suffer from more extreme shock. The pelvis is often distorted and deformed. Displacements may be detected by palpating the pubic region and iliac crests or by a finger in the rectum. The patient is conscious of the loss of all pelvic support and is quite helpless. Any movement such as coughing, or heavy breathing, may cause the greatest distress. Shortening may be found by measuring from the umbilicus to the ankle. Widespread ecchymosis is the rule.

Sometimes there are serious complications. The urethra, bladder, rectum, vagina and the great vessels and nerves may be involved. Rupture of the urethra in my experience occurs most frequently after partial and isolated fracture in the region of the symphysis pubis or from injury to the perineum without fracture.

Rapid death may follow the tearing of the large pelvic veins, or pulmonary embolism may occur at a later date. Gangrene of the leg may develop from injury of the external iliac artery and large extravasations of blood may be followed by suppuration. It is obvious that the lumbo-sacral cord may be involved in any fracture in the region of the sacro-iliac joint, or the sciatic nerve may be stretched or crushed, giving rise to prolonged and protracted neuralgia.

Rupture of the urethra and bladder must be dealt with immediately and directly. Retention or extravasation of urine brook no delay. Reduction and fixation of the fractured pelvis cannot be postponed in the presence of such urgent problems.

I have operated recently upon seven cases of ruptured urethra<sup>4</sup>. The injury does not, as a rule, occur in the membranous portion. It is far more common in the bulbous portion of the urethra, well in front of the triangular ligament, but the site of rupture is often near the neck of the bladder above the triangular ligament in cases of extensive pelvic fractures. It is noteworthy that if the membranous segment is severed, a tight stricture in the process of healing is the exception and not the rule. For many years it was taught erroneously that the common site of rupture was between the layers of the triangular ligament, and that when this occurred an unmanageable stricture was frequently the result. Rupture occurs, in my experience, in male patients between the ages of 30 and 40, but some French authorities state that it occurs more often in boys. When the rupture is in the bulbous portion, the common situation, there is almost invariably a perineal hæmatoma, and blood trickles from the meatus immediately after the injury. There is an intense but ineffectual desire to pass water. Local pain is severe. If the patient has emptied the bladder before the accident, and this information should always be asked, there

will be no extravasation of urine. Even if the bladder is full at the time of the accident, extravasation is prevented often for many hours by a reflex spasm of the compressor urethrae muscle. This beneficent and enduring spasm is nature's first aid to the injured. If the urethra is only partially torn, blood will continue to trickle from the meatus, but when the division is complete the retraction of the parts favours hæmostasis. After complete division the line of least resistance for the escape of blood is into the cellular tissues. It follows that the gravest rupture is accompanied by the largest perineal hæmatoma, partial ruptures are indicated by more constant bleeding through the meatus, and a smaller hæmatoma. Bailey<sup>2</sup> reminds us that a black patch on the glans penis is a sign of fatal omen. It probably indicates that the whole of the corpus spongiosum is infiltrated with urine.

The diagnosis of ruptured urethra presents no real difficulty, but in coming to a decision the possibility of a ruptured bladder above or below the reflection of the peritoneum must not be lost sight of.

When confronted with a case of ruptured urethra it is well to have some definite plan of action. Much of the literature on the subject is not helpful in this respect. I believe that operation should be undertaken in all cases whether an instrument can be passed or not. I believe also that the bladder should be opened by suprapubic cystotomy in every case, for two reasons: In the first place, there is no difficulty in passing a catheter in retrograde fashion from the bladder to the position of the rupture. The point of the catheter can then be exposed in the perineum, and is a certain guide to the proximal end of the divided urethra. Secondly, suprapubic drainage permits healing of the divided ends of the urethra without infection and resultant stricture.

The immediate treatment of ruptured urethra is of such primary importance that a short account of the

operation may not be out of place.

*Operation.*—When the patient is first seen he is given a hypodermic of morphia. If the bladder is felt distended, or the patient states he has not passed water for some hours, a suprapubic puncture with trocar and cannula is made before removal to hospital. After these two preliminary measures there is no need for hurry. In hospital the suprapubic and perineal regions are shaved and disinfected. The anterior urethra is washed out with 2 per cent. mercurochrome solution or other antiseptic by passing the nozzle of a suitable syringe into the meatus. No attempt should be made to pass a catheter unless the diagnosis is in doubt. If the patient is not in a state of extreme shock, and if the fractured pelvis permits rolling him on his side, a spinal anæsthetic should be given, together with an injection of ephedrine. When anæsthesia is secured, the buttocks are brought down over the end of the table. The legs are spread out and held in position by two assistants. (The lithotomy position is undesirable, as it puts the injured parts under tension.) The bladder is opened above the pubis, and with the finger as a guide, a catheter\* or an instrument specially designed by the writer (Fig. 1), is passed in retrograde fashion. The

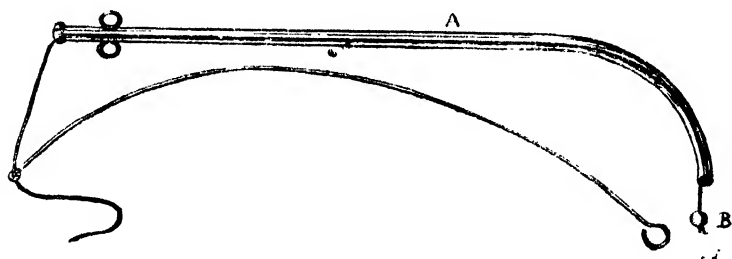


FIG. 1.—Author's instrument for retrograde catheterization: a metal ball (B) held in place by a thread forms the nose of the catheter (A). The thread is passed through by the stylet shown.

\* The catheter if metal should have two adjacent eyes so that a needle and thread can be passed through for attachment to the rubber penile instrument.

instrument or catheter is held in position by an assistant. The legs are now semi-flexed on the abdomen, and a long median or transverse incision is made in the perineum. Blood clots are cleared away; crushed tissues are excised and bleeding is controlled. The operation area always should be rendered quite dry. The instrument in the suprapubic wound is seen coming through the proximal end of the rupture (Fig. 2); a rubber catheter is passed through the penile portion, and both instruments are joined by a stitch (Fig. 3). The suprapubic catheter is withdrawn, carrying the

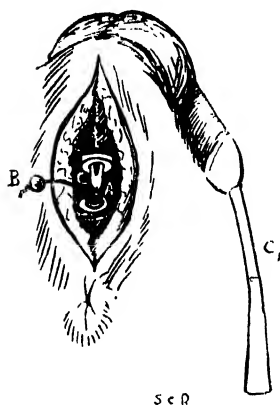


FIG. 2.—The instrument is exposed in the perineum coming through the proximal end of the rupture (A). The ball (B) is cut off and the thread stitched to the rubber catheter (C).

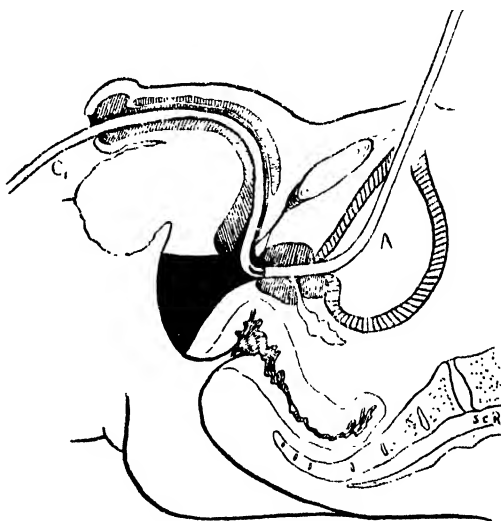


FIG. 3.—The rubber catheter is pulled by the thread into contact with the metal instrument and the latter is withdrawn.

rubber catheter with it into the bladder. A long thread is attached to the end of the rubber catheter now in the bladder and this thread is pulled through the suprapubic wound, and secured to the skin or drainage tube. The catheter is anchored in this way. Four or five fine catgut sutures are used to unite the ends of the ruptured urethra over the catheter in the perineum. "Bipp" is smeared lightly into the recesses of the wound and the skin is closed with superficial drainage. A tube is left in the bladder and the end of the bed is raised

to assist suprapubic drainage (Fig. 4). Each day after operation the bladder is gently irrigated through

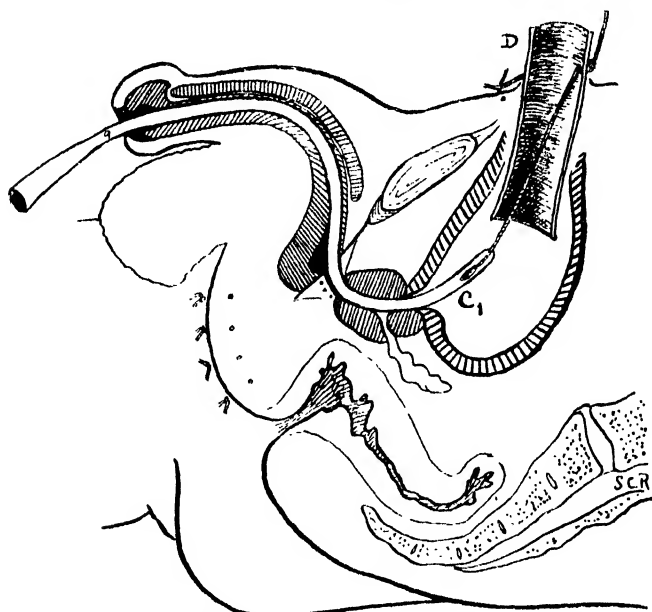


FIG. 4.—The rubber catheter is pulled through the rupture and anchored to a suprapubic drainage tube.

the retained catheter. Once every four or five days it is changed by attaching a fresh one to the meatal end of the one in use, and pulling the catheter which is *in situ* through the suprapubic wound by means of the attached thread. At the end of a fortnight the retained catheter and suprapubic drain are discarded. Occasionally there is leaking from the perineal wound, but usually both wounds are healed and the patient is passing water normally within six weeks.

The patient should be seen occasionally to make certain by instrumentation that no progressive stricture is in process of formation. By employing the retention catheter for about a fortnight and substituting suprapubic for perineal drainage, the following advantages are gained: (1) Nursing is simplified. (2) Scar formation in the perineum is minimized. (3) Change of catheter is simplified.

(4) Convalescence is hastened.

Bailey and others only employ the indwelling catheter when the rupture of the urethra is intrapelvic, but I have found it very satisfactory in all cases.

#### RUPTURE OF THE BLADDER

A ruptured bladder can never be palpated, and a catheter passes freely through the urethra. In one case under the care of the writer, the catheter passed through the rupture in the bladder into the peritoneal cavity, and blood-stained urine was withdrawn in moderate quantity. This led to a delay in diagnosis. Later, at operation, it was of interest to note that when a catheter was passed with the abdomen open, the line of least resistance was through the rent in the bladder.

The bladder may be ruptured without fracture of the pelvis or, in fracture cases, quite independently of the broken bones. If the rupture is below the peritoneal reflection it will be found sometimes in an accessible position in front, sometimes low down out of reach in the region of the trigone. If the rupture is above the peritoneal reflection it will be located as a rule, either in the fundus or posteriorly. Intra-peritoneal rupture is the more common.

Whether the urine is extravasated into the space of Retzius and towards the anterior abdominal wall, or freely into the peritoneal cavity, the symptoms of the inevitable toxæmia may be delayed for one or two days.

Extravasation of urine following trauma to a healthy bladder is a very different matter to that following ulceration and rupture of the urethra behind an old-standing stricture. In the latter case the leak is followed rapidly by cellulitis, rigors and high temperature. The diagnosis is not difficult. As in the case of ruptured urethra there is an irresistible but ineffectual desire to pass urine. A catheter can easily be intro-

duced through the urethra, but a very little blood-stained urine is the only reward. The small amount withdrawn is significant if the patient has not passed water for some hours before the accident.

Later the nature of the case becomes increasingly clear by the local rigidity, the onset of vomiting, and other evidence of commencing peritonitis.

*Operation.*—It is unwise to waste time in making a suprapubic incision of small dimensions in the hope that the rupture may be extraperitoneal. Not only is the intraperitoneal rupture more common, but if the opening is found below the peritoneal reflection, the empty bladder and the extravasated urine and blood makes it difficult to locate. Ample room is required. The intestines are packed off, the table is tilted and a good view of the pelvic viscera is secured. Blood and urine should be removed by suction if a suitable apparatus is available. The rupture in the bladder is sutured in two layers and the line of suture covered by an omental flap<sup>5</sup> (Fig. 5). A

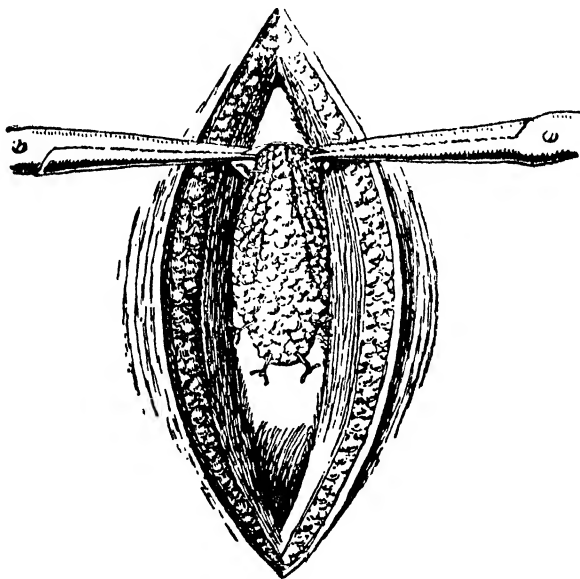


FIG. 5. Omentum covering the sutures in ruptured bladder. (From "Operative Surgery," London: Baillière, Tindall & Cox.)



small drain is passed to the line of suture, but as a rule the bladder need not be directly drained. A self-retaining catheter, however, should be employed for a few days and no distension allowed during the first fortnight. When suture cannot be properly carried out, or when bleeding is free, drainage of the bladder is the safest procedure.

*Prognosis.*—If after pelvic fractures, the result of great violence, a patient succumbs, his death follows extreme shock and multiple visceral lesions or is the result of injuries in regions remote from the pelvic fracture. If a patient survives his injury a couple of days the future outlook is often good, and many patients will be able to return to hard work after the lapse of six months to a year. This applies to all fractures of the pelvis whether simple or complicated.

*Treatment of the fracture.*—When the pelvic girdle is broken in front and behind, the treatment depends upon whether there is gross displacement or whether the fragments lie in good position. If there is displacement the patient is anæsthetized and an attempt is made by manipulation and traction to bring the fragments into good position. Reduction may be very successful at the first attempt, or it may be necessary to restore the alignment gradually by heavy traction. Considerable success follows immediate manipulation, but a residue of deformity frequently remains to be corrected.

As in fracture of the long bones, the prognosis depends upon the success of reduction. By traction on the leg, the side of the pelvis which has slipped upwards can be brought down. An assistant exerts vigorous extension while the surgeon, guided by the X-ray picture, attempts reduction by manual efforts. Traction should be maintained afterwards through the medium of a Thomas splint bent at the knee. The hip is also flexed during the after-treatment to relax the muscles. Fixed traction will not succeed for

obvious reasons. It is a pull on the side of the pelvis at which the surgeon aims, and this can only be accomplished by weight and pulley. A weight of twenty pounds attached to the end of the splint is usually sufficient. Counter extension is obtained by raising the end of the bed. A Thomas splint is applied to the leg on the sound side and slung to facilitate nursing. Pin or tongs traction is most effectual in the gradual reduction of upward pelvic displacements. One of the many varieties of steel pins should be hammered through the tibia just behind the attachment of the ligamentum patella. A stirrup is applied to the pin in the same way as when skeletal traction is employed for fractures of the femur. The Thomas splints act merely as cradles for the legs when pin traction is employed.

To steady the two sides of the broken pelvis, and to correct "spreading" of the pubic bones at the line of the symphysis, a strong girth is tightly strapped in position round the pelvis between the trochanters and the iliac crests<sup>6</sup>. Cords are attached to two lateral rings in the girth and are passed over pulleys on a Balkan frame. A cross handle is attached to the cords in such a way that the patient can assist in raising himself in the bed for nursing purposes; as he does so the girth automatically tightens (Fig. 6).

If there is little or no displacement, or if the displacement can be corrected by the first manipulative efforts, fixation of the patient on a double Thomas frame leaves nothing to be desired. Jones' abduction frame is also admirable when extension is indicated. Whatever apparatus is used, extension should be applied for six or eight weeks.

Peabody<sup>3</sup> reduces gross displacements in cases of "disruption" of the pelvis by tying the patient's foot to the end of the table and tilting the table into the extreme Trendelenberg position.

Careful manipulation of the pelvis with the patient

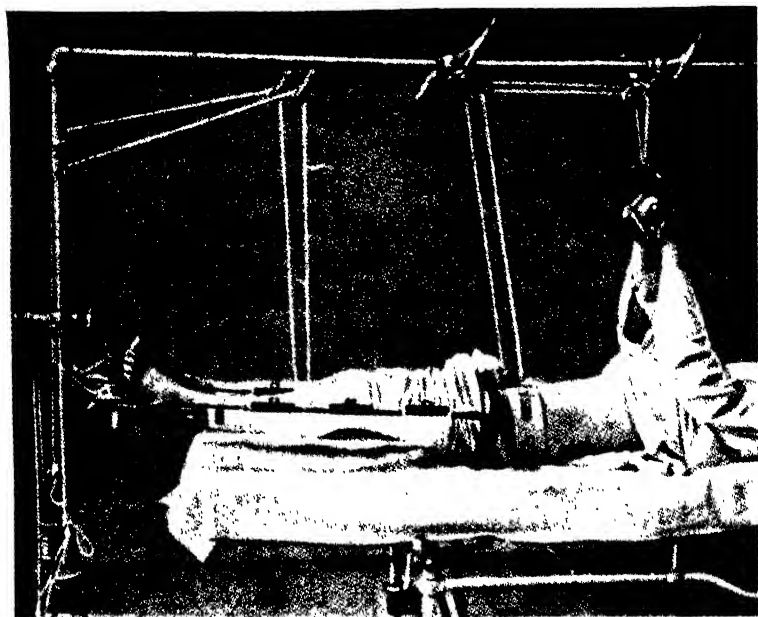


Fig. 6.- Traction is exerted through the medium of Thomas splints. The pelvic girth is in position. The patient is assisting in lifting himself. The bed should be raised at the end and the splints bent at the knee. (From "Injuries to Bones and Joints," London: Baillière, Tindall & Cox.)

in this position may bring about reduction. The manipulations are carried out by Peabody under the guidance of the fluorescent screen. The patient is subsequently treated on a Bradford frame with a twenty-pound extension on the leg of the affected side. Incidentally, this writer states that there are only sixty-five cases of disruption of the pelvis mentioned in the literature. Visceral complications are rare in such cases, but fractures of the transverse process of the fifth lumbar vertebra are not uncommon.

The two X-ray photographs here reproduced (Figs. 7 and 8) show such a case recently under the care of the writer. The right sacro-iliac synchondrosis was disarticulated, the pubic joint was torn open, the pubic arch was broken on the right side, the coccyx and several lumbar transverse processes were also fractured. The left side of the pelvis was displaced upwards. Treatment along the lines suggested above restored the positions of the displaced fragments and resulted in a good recovery. The patient (a nurse) was run over by an omnibus. The shock was so great



FIG. 7.—Disruption of the pelvis. The sacro-iliac joint on the left is dislocated. The pubic joint is torn open. The inferior ramus of the pubis is broken on the right. The coccyx and several transverse processes were also fractured.

that no treatment of the fracture was attempted for ten days. She was able to resume her duties within twelve months.

In contrast to such cases, a fracture of the pelvic girdle in front and behind may escape recognition until demonstrated by X-rays. I have seen a case in which the ilium was split from the lower angle of the sacro-iliac joint to the middle of the crest. The pubic arch was broken above and below the obturator foramen on the opposite side. The signs and symptoms after the accident (overturning of a motor-car) were quite negligible. The patient could move her legs freely; there was no shortening on measurements from the umbilicus to the ankle; the crests of the ilium were in normal position, pressure caused no discomfort. She was kept in bed for six weeks without any fixation apparatus. She reported after two months that she danced all night, galloped on horseback and could do



FIG. 8.—Disruption of the pelvis. Same case after the displacements have been reduced by manipulation and traction.

anything she ever did before.

Of the isolated fractures of the pelvis which do not break the pelvic ring, I found two cases of fracture of the acetabulum of interest. Both were "text-book" varieties.

In the first, there was a dorsal dislocation of the hip with fracture of the posterior rim of the acetabulum. The diagnosis was made simple by the fact that each time the dislocation was reduced the head of the bone again left the socket when manual extension was released. Extension was in consequence maintained until a Thomas splint was in position with the tapes firmly tied to the lower end. The patient was allowed to walk with the aid of a caliper after six weeks. No limitation of movement or disability resulted.

Such cases are rare; the treatment is simple and satisfactory. The second case was a fracture of the floor of the acetabulum with dislocation of the head of the femur into the pelvis. The diagnosis of such

a condition is not easy. Movements are restricted in every direction and there is severe pain. Shortening is insignificant. An impacted fracture of the neck of the femur may be erroneously suspected.

In cases of fracture the trochanter is prominent and greatly broadened, but when the head of the femur is driven through the floor of the acetabulum the prominence of the trochanter is found wanting. For the reduction of such a condition spinal anaesthesia is recommended. Free movements of the femur are employed first to disengage the head, then powerful traction is exerted. Lateral traction in addition to direct traction will be found of assistance. After reduction the case is treated as if for fractured femur with the Thomas splint and preferably skeletal traction. When applying skeletal traction to a case of this kind, i.e. when there is no fracture of the femur or detachment of one side of the pelvis, it is best to pass the nail or pin through the femur not through the tibia. In this way, the ligaments of the knee joint are saved from stretching. On the other hand, when there is a fracture of the femur, or when the side of the pelvis is detached, a pull on a nail below the knee does not loosen the knee joint and has many advantages over femoral extension.

*Fractures of the ilium* alone splint themselves. The bone is invested by muscles inside, outside, above and below. The patient should be kept in bed for a couple of weeks and then allowed to go about with an encircling pelvic support of the corset variety.

*Fracture of the ischium* is rare. In simple cases there is no treatment except rest. Occasionally such fractures involve the acetabulum and the head of the femur is drawn with the fragment towards the sacrum. The sciatic notch may be partially obliterated. Heavy weight and pulley extension following preliminary manipulation is the most obvious treatment.

*Fracture of the sacrum.*—This occurs usually from

direct violence such as a kick from a horse. I have seen a case of transverse fracture in a child of 12. She fell from a swing on the sacral region. The fracture was discovered by X-rays three weeks after the accident. The coccyx was also broken and caused some local pain. When there is displacement pain is severe. If there is much displacement defæcation and urination may be interfered with by direct pressure or by nerve involvement.

Finally, it is good practice to administer thyroid extract in daily doses of two grains in cases of severe fracture of the pelvis as a prophylactic against pulmonary embolus. Walters<sup>7</sup>, of the Mayo Clinic, has pointed out that the incidence of embolus is reduced in general surgery by this simple precaution. There have been many cases of death from embolus after injury to the bladder, urethra and pelvic veins.

#### References.

- <sup>1</sup> Wakeley, C. : *Brit. Journ. Surgery*, 1929, xvii, 22.
- <sup>2</sup> Bailey, H. : *Ibid.*, 1927, xv, 370.
- <sup>3</sup> Peabody : *Arch. of Surgery*, 1930, xxi, 971, 1929, i, 126.
- <sup>4</sup> Wheeler : *Brit. Journ. Urol.*, 1929, i, 126.
- <sup>5</sup> *Idem* : "Operative Surgery," 4th Ed., 410.
- <sup>6</sup> *Idem* : "Injuries to Bones and Joints," 2-13.
- <sup>7</sup> Walters : *Proc. Mayo Clinic*, 1926, 1051.

# Traumatic Dislocation of the Hip

By ARTHUR ROCYN JONES, M.B., B.S., F.R.C.S.

*Surgeon to the Royal National Orthopædic Hospital.*

THE structure of each part of the body is an expression of its function, and no two comparable regions illustrate this principle better than the great enarthrodial joints; the hip with its deep cup enveloping the round head of the femur is designed for stability at the expense of mobility; whereas the reverse obtains at the shoulder with its large humeral head and small shallow glenoid cavity. This inherent stability of the one joint and instability of the other explain why dislocation of the shoulder is a common casualty, whereas that of the hip is an uncommon one. Steinke, who investigated the surgical records of the Episcopal Hospital at Philadelphia during a nine-year period, found only ten cases of traumatic dislocation of the hip amongst 6,000 surgical injuries. It is possible that with the rise of accidents due to increased transport facilities this figure may be higher.

Although dislocation of the hip is still one of the rarer experiences of medical practice, the treatment of this gravely crippling condition may present considerable difficulty. The prevailing lesion at the hip region due to sudden violence is fracture of the neck of the femur, and the elderly of both sexes swell the list of sufferers from such an accident. Dislocation, however, usually occurs amongst young and middle-aged men whose activity and occupation expose them to the chances of the disruptive force necessary for the dislodging of the femoral head. The luxation generally occurs when the thigh is suddenly abducted and the



muscles, especially the adductors, relaxed and off their guard. This rapid manœuvre pushes the head of the femur against the lowest part of the socket, the very area where the acetabulum is deficient and the capsule weakest. If the abducting force continues the head escapes from the cavity. Dislocation may also occur when the thigh is adducted, flexed and rotated inwards, the head being then forced through the lower and posterior part of the joint. The direction in which the head travels after leaving the socket depends upon the direction of the violence, the way the limb is rotated, the subsequent movements of the patient, and the unskilled interference of friends.

Dislocation of the hip is classified into two regular types—namely, *anterior* and *posterior*, in both of which the ligament of Bigelow is for the greater part intact. When this structure is ruptured the head may wander irregularly into any position.

*Posterior dislocation* is much the commoner, and of this there are two varieties, dorsal and sciatic. Roughly, half the number of all hip dislocations are dorsal, i.e. the femoral head lies on the dorsum ilii and above the obturator internus muscle; sciatic dislocations come next in frequency, the head lying near the great sciatic notch and below the obturator internus.

*Anterior dislocation* is characterized by the head lying in front of the plane of Bigelow's ligament and placed either in the obturator foramen or well forward on the pubic bone, the location of the head giving its name to the variety of dislocation, i.e. obturator or pubic.

#### DIAGNOSIS

Important points in the diagnosis are the history of the accident, and the general attitude of the injured limb with its limitation of movement. Often in spare patients the displaced head can be seen and palpated. A useful guide to the direction in which the head of

the femur is pointing can be obtained by observing the position of the internal condyle which lies vertically below the head. A comparison of the short sides of the two Bryant's triangles will indicate the measure of shortening present, but sometimes there may be actual lengthening. Lastly, a radiogram should always be taken.

*Posterior dislocation.*--In posterior dislocation the attitude of the limb resembles the third stage of an



FIG. 1.—Dislocation of the hip, before reduction.

untreated tuberculosis of the hip joint, i.e. flexion, adduction and internal rotation, with the foot often resting on the foot of the sound side. This attitude is quite typical and almost diagnostic, if coupled with a history of great violence. It is interesting here to note that this is also the attitude accompanying pathological dislocation of the hip due to disease of the

joint or paralysis of muscles. Active movement at the hip is almost absent, and passive movement much restricted. The deformity of the limb is apt to be less pronounced in the sciatic dislocation.

*Anterior dislocation.*—In anterior dislocation the thigh is flexed, abducted, and externally rotated. The limb is not short; it may even be lengthened. The head may be seen and felt in the groin, and sometimes there is pain due to pressure on the anterior crural nerve.

#### TREATMENT

The patient should lie on blankets placed on the floor and a general anæsthetic administered to obtain relaxation of muscles. There are several methods of reduction, but the following are amongst the simplest. In all the thigh is held flexed during the manipulations, and an assistant should fix the pelvis.

(1) *Gravity method of Stimson.*—In this method the minimum force is employed, and it is possible to carry it out without anæsthesia. The weight of the limb is the means of traction employed to overcome the resistance of muscles. The patient is placed face downwards on a couch or table with the lower limbs projecting over the end. The hanging limb after a time will bring the head close to the point of exit from the joint, and may actually reduce the dislocation. To aid the procedure, the knee is bent and the surgeon exerts pressure downwards on the calf of the leg. This method is not so uniformly successful as the ones to be described, but when effective it is the least damaging to soft parts, and can always be tried in patients for whom an anæsthetic is undesirable.

(2) *Direct method of Allis.*—Flex the thigh and knee; this brings the head near the point of exit from the joint. With the hands under the leg below the knee, lift upwards in the axis of the thigh. If reduction fails on this manoeuvre, then rotate inwards and lift,

and gradually extend, a second assistant at the same time exerts pressure under the great trochanter.

(3) *Circumduction method of Bigelow*.—Flex the hip and knee. With the hands under the leg exert strong traction along the thigh as in the previous method, at the same time adducting and rotating the femur inwards by circumduction. If this fails reverse the circumduction, by abducting and externally rotating, and end the movement with extension of the hip.

*Treatment of anterior dislocations*. — (1) *Allis's method* : Flex and abduct the thigh and exert traction along the shaft of the femur by pulling on the flexed knee; at the same time an assistant pushes the head outwards. Then adduct, and the head should slip back into the socket. (2) *Bigelow's method* : Flex the thigh and apply traction whilst abducting the limb, then adduct and rotate strongly inwards, ending up with extension. The movements should merge into one another, producing circumduction.

*After-treatment*.—Once reduction has occurred there is little tendency to re-dislocation unless there is a complicating fracture of the rim of the acetabulum. Therefore in the uncomplicated dislocation little after-treatment is required. The legs should be tied just above the ankles to prevent abduction; at the end of ten days slight active movements should be permitted and the limbs tied together at night. This regime should be kept up for three weeks when a little weight-bearing, first with crutches, should be permitted. At the end of five weeks restoration of function should be complete.

In fracture of the edge of the acetabulum there is great risk of re-dislocation. In this class of case after reduction of the dislocation, the pelvis and lower limb should be incorporated in plaster of Paris in abduction for six or eight weeks. At the end of this time the plaster is removed and the patient allowed active movements in bed for another two weeks before weight-

bearing is permitted.

*Old unreduced dislocations.*—Like all old dislocations, those of the hip become more intractable as time goes on. It is, however, possible to reduce in some cases up to six weeks after the injury. Beyond that time direct traction should first be employed for three weeks by means of a pin passed through the lower end of the femur, and to which a weight of 30 pounds or more is attached. After the traction has been applied for this length of time an attempt should be made to reduce the dislocation, and it is possible to achieve success even with a dislocation as old as six months.

*Reduction by operation.*—For recent dislocations that resist reduction owing to the imposition of broken fragments between the elements and for dislocations of over six months' standing, open operation offers the only chance of success. The best method of approach is by means of the Smith-Petersen incision which begins just below the anterior superior iliac spine and continues downwards and slightly forwards along the thigh for about four inches; from the upper end of this wound the incision is carried backwards for four or five inches along the crest of the ilium. In front the sartorius is separated from the tensor fasciæ femoris and the latter is split along the course of its fibres. The gluteal muscles are cut through about an inch below the crest of the ilium for the whole length of the posterior part of the incision. The muscles are then separated from the ilium by a rougine and turned downwards exposing the capsule of the hip joint. The head of the femur is manipulated into position, and any obstructing fragment of broken bone is either reattached or removed. The muscles are re sewn into place, the wound closed, and if there is any fracture the pelvis and limb to below the knee are encased in plaster of Paris for six or eight weeks. The rest of the after-treatment is much the same as in the recent uncomplicated case, but the time for weight-bearing

should be a little more prolonged.

### REMARKS ON REPORTED CASES

(1) *Dislocation of the hip in adults.*—An analysis of many of the cases reported in the literature shows that particular kinds of accident predispose to the production of dislocation of the hip. The most common cause is a fall from a height such as that of falling out of a window, or from a roof. Presumably the forcible abduction of the limbs when landing on the ground is responsible for the luxation. Motor-car accidents also are in recent years contributing towards this disability, but often in such casualties there are other fracture complications, and in some instances these last have completely diverted attention from the state of the hip, with the result that the dislocation has been missed for some weeks in spite of the typical attitude of the limb.

(2) *Dislocation of the hip in children.*—Dislocation of the hip in children is even much less common than in adults. Choyce collected 59 cases in the literature up to 1924; of these 42 occurred in boys, which rather suggests an analogous etiological factor to that existing in adults—namely, that the more strenuous individuals are more exposed to the chances of mishap; boys by nature play more vigorously at their games than do girls at theirs. Again, two out of every three of the dislocations are dorsal. The prognosis in children is somewhat more unfavourable than in adults; recent observations seem to indicate that rupture of the ligamentum teres exerts a depressing influence on the nutrition of the thick cartilaginous envelope of the child's femoral head. Late changes of the nature of fragmentation or rarefaction of the head may occur.

### References.

- Steinke : *Ann. Surgery*, 1914, lx, 617.  
Choyce : *Brit. Journ. Surgery*, 1924, xii, 52.

# The Treatment of Fractures of the Femur

By S. L. HIGGS, M.A., M.B., F.R.C.S.

*Surgeon to the Royal National Orthopædic Hospital; Assistant Surgeon to the Orthopædic Department, St. Bartholomew's Hospital.*

**F**RACTURES of the femur are best considered under three groups: those affecting the upper end, those of the shaft of the bone, and, lastly, those of the lower extremity. The treatment and difficulties in each case are different.

## FRACTURES OF THE UPPER END

The commonest in this group is the so-called "intra-capsular fracture," or fracture of the neck of the femur. Among elderly people this is one of the most frequent, the most serious and worst treated fractures in the body. Non-union so often results that it has been regarded as inevitable and the patient doomed to become permanently crippled. This non-union has been attributed to three reasons: the age of the patient, as it usually occurs in old people, lack of blood supply to the broken-off head of the bone, and the presence of synovial fluid. These may be contributory factors, but they are not the cause. Failure to reduce, and afterwards to fix the fracture, is the cause of non-union in the majority of cases. Except in the rare event of true impaction, unless these measures are carried out successfully, union is impossible, and no further cause need be sought to explain the failure to obtain a satisfactory result.

The appearance of impaction as seen in an X-ray film should be distrusted. A lateral view of the hip joint cannot be taken, and backward displacement or rotation of the neck below the fracture will not be appreciated in an antero-posterior view. Good stereo-

scopic photographs will demonstrate the true state of affairs but, in most cases, so soon after the injury it is neither wise nor, indeed, possible to send the patient to have such pictures taken. A portable X-ray will show the fracture, but clinical examination must be relied upon to decide whether firm impaction is present or not. If the leg lies with the foot turned outwards and there is pain on attempted movement of the hip joint, with inability to rotate the leg, then impaction is not present, and the fracture must be set if it is ever to unite.

In patients of very advanced age, in those whose health is such that a prolonged anæsthetic would be dangerous, or where the mental condition is unsatisfactory, any attempt at achieving firm union may have to be abandoned, and this should be made quite clear to the relatives. In such cases the limb should be steadied between sandbags and, as soon as possible, the patient got up into the sitting position and afterwards into a wheel-chair. Later, a weight-bearing appliance may enable the patient to move about unaided. If weight is taken off an ununited fracture the leg will become increasingly short, due to riding upwards of the shaft and this, with the accompanying adduction and eversion deformity, will produce pain and increasing disability. The appliance, therefore, should be worn for a year or more, until such fibrous tissue as may have formed has become really strong and able to withstand the weight thrown upon it. This line of treatment can, at best, only lead to a poor result with a varying degree of disablement. Therefore, unless absolutely contraindicated, the fracture should be set and fixed with a view to obtaining bony union with complete restoration of function.

Many operations have been devised to secure this result, such as fixing the fragments together with a bone graft or an ivory peg. Although successful in skilled hands and perhaps more certain in its results,



the operation is a severe one for an elderly or debilitated patient. Good surgical team work is essential, and the period of immobilization is not appreciably shortened. It may be the only means of promoting new bone formation in cases of delayed union, but as a routine method of treatment it is much too specialized to justify general use.

*Method.*—The following non-operative method may be carried out if necessary in the patient's own home. Ample assistance, not necessarily skilled, is required and a knowledge of plaster of Paris technique.

Some form of support for the pelvis is essential. A plaster table of the Hawley type is the most convenient, but failing this a simple pelvic rest with a perineal bar will answer the purpose, provided the shoulders and head can be independently supported. A general anæsthetic is given and the patient then lifted on to the support. Strong manual extension is applied to the injured limb, fixation of the pelvis being secured by the perineal bar.

The leg is then widely abducted and, at the same time, internally rotated to its full extent. To steady the pelvis the sound limb should also be abducted. (At this stage crepitus may often be felt, indicating that the fracture surfaces are in contact). By this manœuvre the distal part of the fractured neck swings down into position, the strong capsule and especially the Y-ligament acting as a fulcrum. Strong internal rotation closes the anterior gap in the fracture and, if the position of the limb is maintained, the fracture is held set and splinted by the tense capsule. The problem now is to keep this position for the necessary period whilst union is occurring. Ordinary extension or splints are useless. The only efficient method is to apply a plaster of Paris case. The whole of the injured leg, the pelvis, and the chest wall on the opposite side are padded with an abundance of soft wool and the bony prominences protected with felt. The knee

joint should be flexed at about  $30^{\circ}$ . Plaster of Paris bandages are then applied and well moulded around the opposite iliac crest and carried upwards over the chest wall towards the axilla on this side. The other thigh need not be included. The sound leg is then left free to aid in lifting. This may appear to be most uncomfortable, both as regards position of the limb and dimensions of the plaster, but such is not the case.

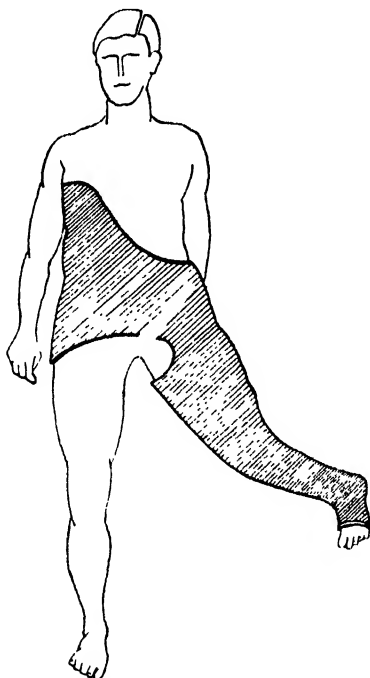


FIG. 1.—Plaster of Paris case used in the treatment of fractures of the neck of the femur.

As a rule the general condition of the patient at once improves. Pain from movement of the fracture disappears, and if the plaster has been well applied there should be no subsequent discomfort. The after-care and nursing are all-important. The bed should be narrow and should have a firm mattress supported by fracture boards. The head—not the foot, as in ordinary extension—can be raised on blocks. The chances of chest or digestive complications in elderly people are

thus diminished, and this is an important argument in favour of this method of treatment. At least once every day the patient must be turned on to his face. With practice and the co-operation of the patient this can be managed by one person. The abducted leg which is in plaster acts as a lever with which to swing the patient over. This change of position enables the back to be attended to, prevents hypostatic congestion of the lungs, and is a welcome change to the patient. An overhead frame greatly facilitates nursing. Almost any pattern will do, and they can easily be

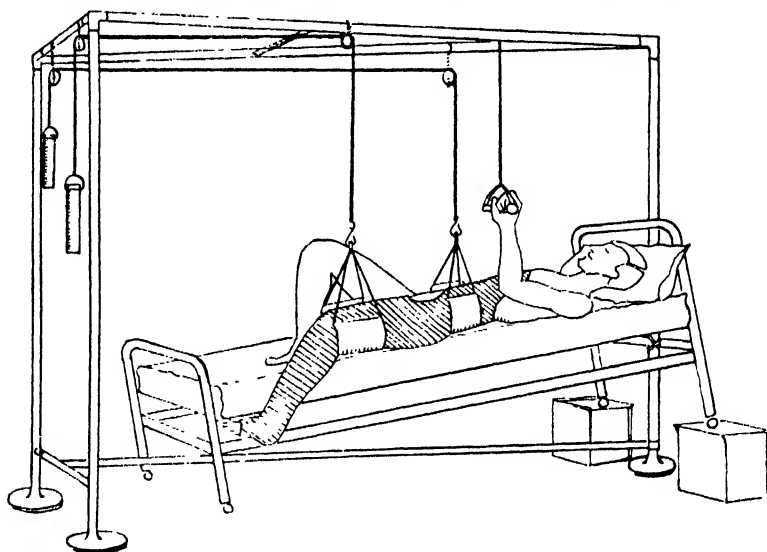


FIG. 2.—Method of suspension of plaster case.

hired. Two webbing slings are made, one to support the plastered leg beneath the knee and the other to go round the waist under the pelvic part of the plaster. These can be readily hooked to counterbalancing weights, and the patient, by means of his arms and sound leg, can raise himself well above the mattress. The physical effort is beneficial and a certain amount of independence from the assistance of others is secured.

The hip plaster must be retained for three months and during this time the knee becomes very stiff,

especially in rheumatic subjects. In order to minimize this it is a good plan to cut the plaster off the front of the foot and leg to just above the knee and to retain it as a kind of lid. Each day it can be removed and the leg massaged and the knee-joint moved from the position of  $30^{\circ}$  of flexion to full extension. All twisting movements which might throw strain on the fracture must be avoided and the plaster lid strapped back between whiles.

Usually after about a week or so the patient becomes quite accustomed to the routine of lifting and turning and settles down to the tedious, but not uncomfortable period of three months. At the end of this time the plaster is cut—an easy matter if proper shears of the Stille pattern are used—and removed. A further X-ray examination should then be made to check position and progress of union. As in other intra-articular fractures new bone formation is very scanty. The only positive X-ray evidence of union occurs at a much later date and is shown by increased density and restoration of trabeculae across the fracture line.

Having completed the three months in plaster a further month is spent in bed, but during this time the limb is left quite free from splints of any kind. The leg as a whole will be found to be in a poor state. It is probable that the lower part of the limb will be rather swollen from venous stagnation, the muscles, especially the quadriceps, will be wasted, and the knee is sure to be somewhat stiff and painful. Movements of the hip, on the other hand, are usually quite free and painless. During this month, therefore, daily massage for the whole limb, active and passive movements for the knee, ankle and foot, and also faradic stimulation of the quadriceps should be given. The hip must be left alone. The leg should be well cradled to permit freedom and the patient encouraged to persevere with active movements. If the overhead frame is retained a sling and pulley can be rigged up to

flex the knee, and this can be worked by the patient himself.

Meanwhile measurements are taken for a weight-bearing walking appliance. The simplest and by far the cheapest type is the ordinary caliper splint with a ring fitting beneath the tuberosity of the ischium and side irons attached to a socket in the heel of the boot. Although efficient, this is not nearly so comfortable or convenient as a more expensive appliance built on the same principle. In place of the ring is a moulded leather "bucket" made from a plaster cast and laced in front. The side steels have joints at the level of the knee and a lock to fix them in full extension. On sitting down the patient can release the catch and bend the knee. In place of the heel socket, the side steels end in a sandal, to which the foot is tightly laced. This slips into a shoe of ordinary appearance. The best type of instrument of this description may cost as many pounds as the simple caliper costs shillings, but there is a fairly good range in between. In any case, a moulded thigh-band is preferable to the ordinary caliper ring and is not much more expensive. Unless carefully adjusted for length any of these instruments will fail in their object. When standing the patient should have the sensation of sitting on the ring or band, with no weight on the heel.

At the end of the fourth month, therefore, the patient commences walking with his instrument. Different opinions are held as to the length of time the support should be worn. Too early weight-bearing has ruined many promising results. Consolidation of the fracture is so slow and the mechanical strain on it so great that it would be wise to set the length of time at not less than six months. In old people, or where the X-rays show delayed or doubtful union, this should be extended up to a year. Even if bony union is not achieved, a close, firm, fibrous union will give a good weight-bearing hip-joint and a satisfactory functional

result; but only if it is well protected from strain at the commencement.

The present view, therefore, is that fractures of the neck of the femur should not be regarded with the pessimism of former times. Treatment by reduction and fixation in plaster will, in the majority of cases, achieve bony union and complete recovery of function. The treatment is tedious for the patient, requires most careful supervision, and takes from ten months to a year; but the results and the grim alternative of serious lameness make this amply worth while.

Little need be said of the other common fractures of the upper end of the femur. Those close to or through the trochanters all join up readily. Much separation of the fracture is unusual, but adduction of the lower fragment is fairly constant. Therefore any form of extension which allows of abduction of the limb as a whole will meet the case.

#### FRACTURES OF THE SHAFT

Fractures of the shaft of the bone present an entirely different problem. As a rule union occurs readily, and the chief difficulty is to obtain approximate end-to-end apposition of the fragments. Considerable overlap is usual, and reduction is resisted by the contraction of the powerful thigh muscles. Except occasionally in small children, setting of the fracture under an anæsthetic, followed by fixation in splints or plaster of Paris is not possible. Overriding or angulation will almost inevitably occur. This difficulty in maintaining reduction has encouraged the use of internal splints, such as metal plates. Although the prospect of fixing the fracture once and for all by means of an operation may be attractive, yet the method is one that should be strongly condemned. Unfortunately, it is still widely practised, especially by those who are called upon only occasionally to deal with such fractures. Examples of bad results are only too common.

In the first place, if the operation is undertaken as a primary measure the limb is not in a fit state for surgical interference. At the time of the injury considerable damage to the soft parts, as well as to the bone, is inevitable, and, in consequence, there is a mass of devitalized tissue and extravasated blood. Moreover, the skin may not be in a fit condition for operation. Even with the most scrupulous technique the danger of infection is quite appreciable if the operation is performed at this time. Furthermore, the introduction of a foreign body definitely delays union, and may often promote the formation of a pseudarthrosis in a fracture which clearly would have united quite readily by non-operative measures.

Lastly, the application of a long plate requires a big incision, the division of many blood vessels, and wide separation of the soft parts away from the bone. In consequence of this and of the presence of a foreign body, the thigh muscles, and especially the quadriceps, become adherent and fibrosed, and stiffness of the knee-joint, which cannot be overcome by physical treatment, ensues. It is found, therefore, that non-union and stiff knees are a common sequel to the operation of plating these fractures. In very exceptional circumstances only should the method be employed.

Fractures of the shaft are best treated by strong continuous traction combined with support and lateral counter-pressure at the site of the fracture. There are many ways of carrying out this, but all of them require frequent adjustment and supervision. The Thomas splint, with overhead suspension from a frame, is in very general use, but the mode of applying extension to the limb varies, and it is in this respect that progress has been made. The usual skin extension by means of adhesive strapping may prove adequate, but, on the other hand, has great disadvantages. It is very liable to become loose and to slip before the

period of extension is finished. Reapplication may be difficult if the skin has become sore and blistered. Again, in a strong individual sufficiently heavy extension by this means may not be possible. Lastly, the knee-joint frequently suffers. Stiffness is often unavoidable and may take many months to overcome and, since the pull is through the joint, the ligaments may become relaxed and leave a rather loose joint.

These disadvantages are largely overcome by "skeletal traction." A steel pin, wire or "ice-tongs" can be applied to one of the bones below the fracture and a far more efficient pull exerted. Piercing the bone and leaving a metal instrument protruding through the skin may sound a dangerous procedure, but with proper care no trouble need be anticipated.

*Method.*—X-ray photographs of both antero-posterior and lateral views should be taken; one view is not enough and may be misleading. The displacement is fairly characteristic according to the level of the break. Unless ample skilled nursing is available the case is better treated in an institution rather than in a private house. Most of the apparatus can easily be hired from any of the big surgical supply firms. In the average case a Thomas splint with a suitable sized ring, and a Balkan frame with cords, pulleys, and weights will be required.

The lower part of the thigh and knee are prepared as for a surgical operation. The splint, fitted with flannel slings, and the rest of the apparatus must be absolutely ready for application. The patient is then given an anæsthetic. Gas or a local anæsthetic is sufficient, although a full and more prolonged anæsthesia may make things easier from the surgeon's point of view. With full aseptic precautions, as for an ordinary operation, a Steinmann rustless steel pin is then fixed in position. To do this a small snick through the skin is made with a scalpel just above the level of the adductor tubercle of the femur on the outer side.



Then, drawing the skin slightly upwards, the point of the pin is introduced and thrust straight down to the bone. By means of the special handle the pin is made to transfix the bone and the end is brought well through the skin on the opposite side. Sterile gauze is packed round the puncture holes and bandaged firmly into position. This dressing should not afterwards be touched.

The Thomas splint is slipped over the leg until the ring reaches well up into the groin and the special stirrup attached to the ends of the pin. From this

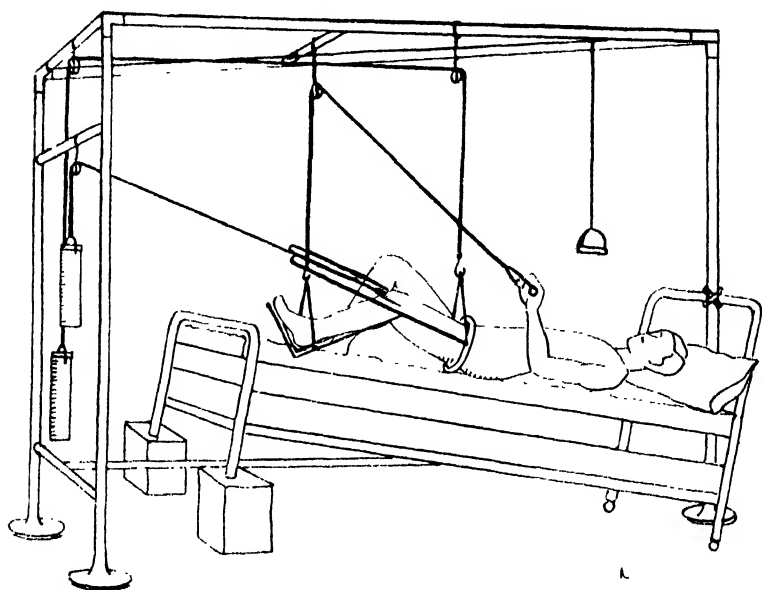


FIG. 3.—Method of extension and suspension used in the treatment of fractures of the shaft of the femur.

stirrup a cord passes to the end of the splint, where it is made fast. The leg and foot are supported with the knee flexed on a hinged attachment to the Thomas splint. The foot of the bed is raised on blocks, and weight extension is applied to the end of the splint itself. This, through the cord and stirrup, exerts traction directly on the lower end of the broken bone and, at the same time, withdraws the ring of the splint from the groin and relieves any pressure. The limb

and splint are counterbalanced by means of the weights attached to the overhead frame so that the patient can lift and move about without disturbing the fracture.

No immediate attempt is made to reduce the displacement. Under the weight-extension the muscle spasm goes and, in a day or two, it will be found by measurement that the overlap has been corrected. The lateral displacement must then receive attention. If the upper fragment is abducted, as usually occurs in fractures of the upper third of the shaft, then the lower part must be made to follow it by abducting the whole splint. The lower fragment is usually tilted backwards, and this must be corrected by a supporting band slung from the side bars of the splint. Similar slings of varying tension support the rest of the limb. The most important of these is the one beneath the fracture itself. The fracture is apt to sag backwards unless this band is kept tight.

As over-lengthening may occur, measurements of the two limbs need frequent checking and the weight adjusted accordingly. At the end of six to eight weeks union should be sufficiently firm to allow the weight extension to be given up. The pin is, therefore, withdrawn, but the rest of the splint forms a convenient support for the leg for the remainder of the recumbent period.

The great advantage of this pin traction is that from the very commencement of treatment the knee can be kept moving. In addition, the thigh is exposed, so that massage and faradic treatment for the quadriceps muscle can be carried out from the beginning. The period of convalescence, therefore, is greatly shortened. At the end of from ten to twelve weeks the fracture should be strong enough to permit protected weight-bearing. A caliper splint as previously described is therefore fitted. It should be worn for not less than three months as angulation through bending of the soft callus is very apt to occur.

Operative treatment should be reserved for cases of delayed or non-union. Delayed union, in most instances, is due to the intervention of soft tissues between the fragments. In such cases, clearing the ends of the bone and locking them together by means of an intra-medullary peg of autogenous or beef bone will usually lead to union. It is not safe to depend on the peg to hold the alignment as angulation readily occurs. Pin traction should, therefore, be applied at the end of the operation.

#### FRACTURES OF THE LOWER END

These fractures usually involve the knee-joint and, therefore, the consequences may be serious. Unless accurate replacement of the fragments is secured, the articular surfaces will lose their normal relationship, and in consequence pain, stiffness, and, later on, osteo-arthritic changes will ensue. For these reasons, if manipulative or extension methods fail, then operative treatment should be undertaken without delay.

The commonest injury of this kind is the inter-condyloid or T-shaped fracture. It amounts to a supra-condylar fracture in which the shaft has been driven downwards separating the condyles. Accurate reduction is difficult. The best method is to insert a steel pin through the crest of the tibia and apply strong traction with a Thomas splint. If this does not bring the condyles together then a screw clamp should be applied under an anæsthetic. This must be kept on for a few moments only, otherwise sloughing of the skin may occur. If this measure fails then the only course will be to operate and screw or bolt the condyles together.

Sometimes a fracture of one of the condyles occurs. In such cases extension treatment is not necessary, and under an anæsthetic it is possible, as a rule, to manipulate the fragment into good position. The knee should then be fixed in a close-fitting plaster of

Paris case and weight-bearing forbidden until the fracture has become firm.

Lastly, mention should be made of fracture-separation of the lower epiphysis. The displacement is usually forwards and is produced by violent hyper-extension of the knee, such as may occur in a heavy tackle at football. The nature of the injury may not be obvious to begin with, owing to the great swelling of the knee, but it should be seen that the tibia lies on an anterior plane to the femur. The lower fragment rotates in its passage forwards and becomes locked in front of the end of the shaft. If treated soon after the injury reduction may be accomplished by manipulation under a deep anæsthetic. The knee is forcibly flexed and, at the same time, the upper part of the leg is pulled forwards by a traction band. If more than a week is allowed to elapse it may be necessary to effect reduction by open operation.

The best exposure is through a long incision along the antero-external surface of the lower part of the thigh. The rectus femoris and the vastus externus muscles are defined and the bone exposed along the line of cleavage between them. By this route very little bleeding is encountered and the fracture is reached with the minimum of damage to the thigh muscles. The lower fragment is then freed and by powerful leverage, combined with flexion of the knee, brought down into its normal position. Whether the fracture be reduced by manipulation or operation, the knee should be maintained in the position of almost full flexion for about three weeks until the danger of re-displacement is past. A convenient way of doing this is to put the limb in a loose-fitting, divided plaster case which can be suspended from an overhead frame. This should be followed by gradual extension of the knee-joint with exercises and faradic stimulation of the quadriceps muscle.

# Injuries of the Knee-joint

By ROBERT OLLERENSHAW, M.D., F.R.C.S.

*Clinical Lecturer in Orthopædic Surgery, Manchester University ;  
Surgeon-in-charge of Orthopædic Department, Salford Royal Hospital,  
and Royal Manchester Children's Hospital.*

THE knee is the most frequently damaged joint in the body, and its traumatic lesions may be discussed under four heads in gradually increasing severity. We may therefore tabulate them as follows :—

- (1) Injuries to the synovial lining of the joint.
- (2) Injuries of the ligaments.
- (3) Injuries to the semilunar cartilages.
- (4) Fractures involving the joint :
  - (a) Patella.
  - (b) Epiphyseal separations.
  - (c) Articular surfaces of femur and tibia.

Fractures of the patella are dealt with elsewhere in this issue, and in the limited space at my disposal I propose to consider three other important sections of the subject, first, simple traumatic synovitis—the most common of the lesser injuries, secondly, semilunar cartilage injuries, and, lastly, fractures of the weight-bearing surfaces of the joint.

*Traumatic synovitis.*—This is a frequent result of a small injury, such as a blow on the joint or a moderate strain. The delicate vascular synovial is crushed and bruised, or torn. There is effusion into the joint with local tenderness. The joint can be fully moved, but with a sensation of “stiffness.” The type of injury which has occurred puts out of the question any gross lesion. A period of rest with the application of an evaporating lotion is desirable for the first 24 hours. If this is persisted in for a longer time there is a very rapid weakening of the muscles which control the joint, especially the vasti, which become soft and

flabby. Intra-articular adhesions are very liable to form, and in order to avoid such occurrences it is important to take steps to prevent muscle-wasting and to encourage the absorption of the effusion.

Early massage of the thigh and knee must be instituted with active contractions of the quadriceps whilst the limb is lying extended on the couch. If the patient is not capable of making active contractions these must be artificially produced by stimulation of the muscles through a Bristow faradic coil. A well-applied bandage should be worn over a layer of wool, but the bandage must only cover the joint and must not be taken higher up the thigh in such a way as to prevent the full contractions of the muscles.

The majority of such patients will usually tolerate a certain amount of walking exercise after the first two days, and the range of movement gradually increases with the steady diminution in the effusion. By such methods the thigh is not allowed to become wasted and weakened, in contrast with the results which follow the misguided treatment of prolonged rest on a back-splint or over a pillow.

In cases where adhesions have formed in the joint and the injury has occurred not more than a few weeks previously, a vigorous course of massage and gradually increasing exercise, preceded by an application of heat, will usually be sufficient to free the joint without recourse to more forcible methods. In old-standing cases, however, a more determined attack must be made and, under a general anæsthetic so as to ensure thorough relaxation of the muscles, full flexion is performed, and it is to be remembered that flexion of the knee is possible normally until the calf meets the back of the thigh. Rotation movements must then be performed and these are to be done with the joint flexed to a right angle at which point the normal rotatory movements are greatest. As Fisher has pointed out, a common adhesion, and

one frequently overlooked, is that which forms in the synovial recess under the internal lateral ligament.

Full rotation movements will free this adhesion. Manipulation such as that described above should be followed by massage and full movement each day until complete recovery is established.

*Injuries to the semilunar cartilages.*—Because of its anatomical attachments and the fact that strains in a “valgus” direction are so common, the inner cartilage is the more frequently torn. Excision of an internal cartilage is a commonplace for all orthopædic surgeons, whereas it is an unusual event to have to remove an external cartilage. In diagnosis one is almost entirely dependent upon the history of the case. The primary injury must be one of some severity, although large tears can be produced by fairly simple means. I have, on a number of occasions, removed a split cartilage which has been damaged whilst the patient was rising from a kneeling position and taking all the strain on one knee-joint. A history of a twist followed by a sudden “locking” of the joint may be caused by other injuries than a torn cartilage, such as a crushing of a synovial fringe, but the sudden “unlocking” is a much more definite and conclusive sign that a cartilage has been torn. I do not advocate operation upon a knee suspected of a cartilage injury upon the history of one attack, but always advise palliative measures and observation. If a portion of the torn cartilage is being engaged in the joint, a further disturbance will occur and make the diagnosis clear. The operation needs no description here, but one must emphasize the necessity for the avoidance of all fingering of the wound. Everything must be handled in forceps, swabs and catgut especially being held in this manner. After operation it is my practice to fix the joint on a back-splint for the first twenty-four hours. After that time the splint is taken off and not replaced until after the sutures are removed and the patient is allowed

to stand, usually the tenth day. From this time movement is encouraged and massage given with faradism to the thigh.

*Fractures involving the articular surfaces.*—Of all the injuries affecting the knee-joint those which cause the most concern to the surgeon are the fractures of the weight-bearing surfaces of the joint. These fractures are not very common, and an examination of the records of Salford Royal Hospital, Manchester—a hospital in the heart of a great industrial area where coal-mines, docks, railway yards, and engineering works are on every hand—shows that about 250 fractures of the lower limb are dealt with in the wards each year, and of these, about 2 per cent. are involving the knee-joint.

On the femoral side of the joint the usual injury is the transverse fracture of the lower end of the femur with a splitting of the condyles forming a T-shaped break. Traction under an anæsthetic is generally sufficient to restore the position of the fragments, but it may be necessary because of backward tilting of the lower fragments towards the popliteal space, due to the pull of the gastrocnemii, to flex the knee slightly and to use a bent Thomas splint. If this is needed it is better to flex the splint, not precisely opposite the joint, but at the level of the transverse femoral fracture. This throws the line of fracture forward and restores the normal “arch” of the femur.

*Localized “punch” fractures.*—In a description of the articular fractures involving the lower end of the femur, the condition termed, by Koenig, osteochondritis dissecans, must be included. This occurs as a punched-out area of articular cartilage, with a bony base, usually from the inner condyle just at the point where the greatest impact takes place in the joint (Fig. 1). In some cases this fragment is anchored by a fibrous attachment in its bed, in others it becomes loose and floats about the joint as a loose body. The



condition occurs in men with fifteen times the frequency with which women are affected. It also occurs during the most arduous time of life. For these reasons, coupled with the site of the lesion, we regard it as a fracture of the articular area. Its correct treatment is an arthrotomy and removal of the fragment

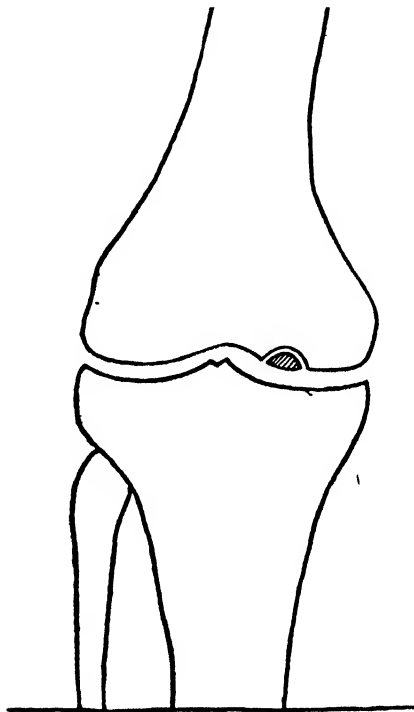


FIG. 1.—“Punch” fracture of internal condyle.

and paring down of the edges of the remaining “crater.” A similar type of limited detachment of a fragment of articular surface is found, though much more rarely, in the tibia.

*Tibial fractures.*—These may be divided into: (1) general compression fractures of the whole upper end of the tibia, (2) separation of a single tuberosity, and (3) avulsion of the tibial spine with associated tearing of the neighbouring cartilage. The results of such injuries depend upon the reduction of the displacement. Results are often poor because of the difficulties met

with in the reduction and by reason of the absorption of bone and cartilage which occurs in the fracture area resulting in an irregular articular surface and, later, the development of changes of an osteo-arthritic nature. Open operation is strongly indicated unless manipulation results in a really adequate replacement of the fragments. Figs. 2 and 3 illustrate, by line-drawings of radiograms, a typical case of severe crush of the

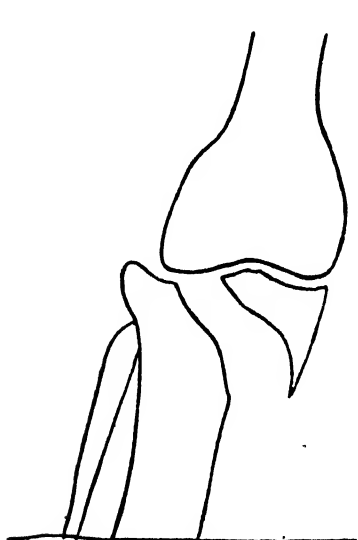


FIG. 2.—Fracture of tibial tuberosities with gross displacement.

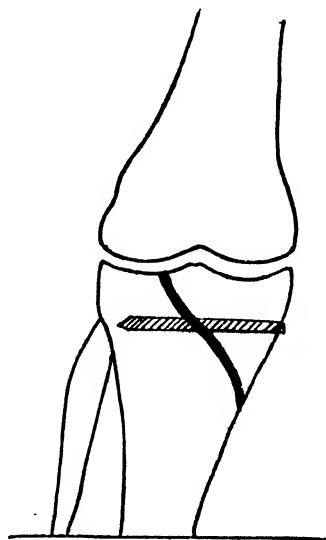


FIG. 3.—The same after open operation and bone-pegging.

tibia due to a forcing of the knee into a varus position by sudden application of great violence. The fragments were replaced by open operation and a bone pin driven through the inner tuberosity to engage the larger fragment. The end result has been excellent, a range of movement from  $180^{\circ}$  to  $80^{\circ}$ , with a perfectly stable joint, being obtained. In my experience the tibial tuberosities are broken more commonly by violence directly applied to the flexed knee or by forced abnormal lateral movement than by the so-called "compression," a term so often employed in describing the fractures of this region. The tuberosities are fractured with about equal frequency.

The fractures in the knee-joint are of such great variety that it is impossible to dogmatize in the matter of treatment and to lay down any rule as to operative or non-operative methods. Each must be dealt with according to its individual needs. All fractures into the joint must be treated at once under full anæsthesia and with all preparations made for open operation should manipulation prove ineffective.

*After-treatment.*—A definite distinction must be made in the later treatment between movement and weight-bearing. Gently graduated movement must be of an active nature and commenced as early as possible after union is obtained. But, in the more severe injuries at least, weight-bearing must be delayed by the application of a walking caliper splint for three months.

# Fractures of the Patella

By A. J. COKKINIS, M.B., B.S., F.R.C.S.

*Assistant to the Surgical Unit, St. Mary's Hospital; Assistant Surgeon, Wembley Hospital; Late Surgical Registrar, St. Mary's and the Royal National Orthopædic Hospitals.*

**F**RACTURES of the patella are fairly common, and they rarely lead to gross disability. Their diagnosis is usually extremely simple, and efficient treatment may be expected to produce perfect recovery. The complications to be feared are very definite. Perhaps the most common is non-union of the fracture, and of the aponeurotic tear which frequently accompanies it. Adhesion of the patella to the femur is less common, but more disabling. A sequel, mostly seen in elderly patients, is osteo-arthritis, while an unstable joint occasionally results from distension of the capsule with blood and serous exudate.

With a clearer conception of the pathology of the fracture and of the essentials of treatment, these complications are becoming more uncommon, and need never occur. A sharp distinction should be drawn between fractures caused by direct violence and those produced by muscular contraction. The former merely splinter the bone, while in the latter the injury to the bone is only a small part of the total lesion.

## FRACTURES BY DIRECT VIOLENCE

Here the bone is cracked by a direct blow or kick. A fall on the knee rarely involves the patella, the violence being received by the tubercle of the tibia. Occasionally a single vertical fissure is present, but more often the patella is comminuted, the fissures running irregularly, or radiating in a stellate manner. The aponeurosis is intact and displacement is therefore very unusual. Some bleeding and serous effusion into the joint is usual, but a marked hæmarthrosis is

rare. This fracture is mostly of little consequence, and provided certain elementary precautions are taken, no disability should result. Rare exceptions to this are provided by fractures in which fragments are displaced into the joint, or in which the bone is grossly disorganized.

*Diagnosis.*—There are obvious signs of local trauma in the form of swelling, well-marked tenderness, and, later on, bruising over the bone. Occasionally the fissures can actually be palpated, and in grossly comminuted fractures the patella feels curiously soft and boggy. In most cases, however, the diagnosis must be presumptive until confirmed by radiography. A lateral view should never be omitted as, without it, it is impossible to exclude backward displacement of a fragment into the joint.

*Treatment.*—In cases of simple fissuring it is sufficient to immobilize the joint in extension for two or three weeks. The most comfortable appliance is a posterior non-padded plaster of Paris gutter, supporting the lower two-thirds of the thigh and the upper two-thirds of the leg. Walking in the plaster may be permitted after a few days, and adhesions of the patella to the femur can be prevented by daily side-to-side movements, carried out gently and commenced towards the end of the first week. After the second week, passive flexion of the knee is started. Active movements are added in the third week, while full use should be possible after the fifth week.

When severe comminution is present, and especially with displacement of the fragments, the treatment must be more energetic. If the hæmarthrosis is of any size it should be evacuated by aspiration. Local anæsthesia is then induced by injecting 10 c.cm. of 2 per cent. novocaine into the hæmatoma in front of the fracture, and a deliberate attempt is made to restore the bone to its normal shape; this is done by pressing the fragments together, and also against

the underlying femur. In these cases a posterior splint is not sufficient, and an anterior plaster of Paris gutter, carefully moulded to the contours of the knee, should be employed in addition. This limits further effusion, and tends to prevent re-displacement of the fragments. After a week, the anterior gutter is removed daily for gentle lateral movements of the patella. The after-treatment is then continued as above, except that walking should not be allowed before the tenth day, and movements should not be started before the end of the third week. Wasting of the quadriceps can be prevented by massage and faradism. The plaster gutters should not be discarded before the end of a month, and full use is rarely possible until at least another month has elapsed.

*Open operation* is only indicated in the following rare cases :—(a) when fragments are displaced into the joint; these should be removed through an incision to one or other side of the patella; (b) when the bone is grossly disorganized; here the best procedure is to remove the patella sub-periosteally, otherwise it will form an irregular bony mass which adheres to the femur, causing much subsequent disability.

#### FRACTURES BY MUSCULAR VIOLENCE

It must be pointed out very emphatically that the patellar fracture in this group is only an incident in a more serious lesion; this is a rupture of the quadriceps aponeurotic insertion. Failure adequately to appreciate this fact has led to many erroneous ideas on the pathology and treatment of the condition.

Occasionally, the rupture is partial, involving the patella with its aponeurotic covering, and only the adjacent parts of the vastus expansions. In such cases, the separation between the fragments is slight. More often the vastus expansions are torn right across, the rupture of the aponeurosis being complete and the separation between the patellar fragments con-

siderable (one to two inches). The aponeurotic tear usually occurs at a slightly different level from the fracture, and the torn fibres tend to curl in between the fragments, and are often responsible for non-union.

The usual cause of this injury is an attempt to recover after a slip. When this happens the knee is

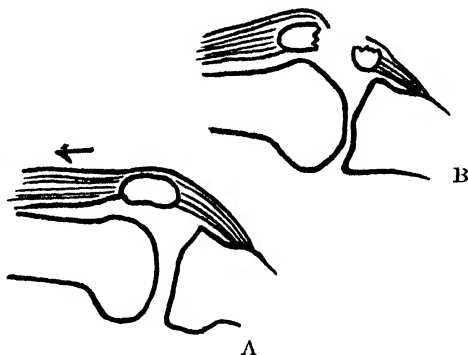


FIG. 1.—Mechanism of fracture by muscular violence.

semi-flexed, and the upper half of the patella is poised on the intercondylar surface of the femur, its lower half being unsupported (Fig. 1). A sudden, unguarded contraction of the quadriceps, in the attempt to recover from the slip, catches the aponeurosis and

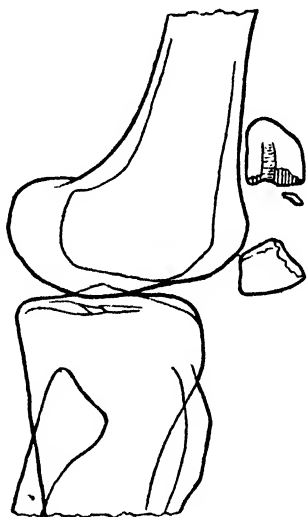


FIG. 2.—Radiogram of typical fracture of patella, showing separation and also rotation of lower fragment.

patella at a disadvantage, and snaps them both transversely. The patella usually breaks in its lower half (see Fig. 2), but the fracture may occur at any level. Fig. 3 illustrates a fairly common site, a flake of the



FIG. 3.—Radiogram of fracture of upper margin of patella, with separation of fragments.



FIG. 4.—The same case after suture of ruptured quadriceps aponeurosis.

upper border of the bone being torn off by the rectus and crureus tendons. In all cases the knee-joint is opened into, and becomes more or less distended with blood and exudate.

*Diagnosis.*—The condition is usually very obvious. The patient can neither stand or walk, and is unable to extend his leg. There is pain and well-marked tenderness at the fracture site, and in nearly all cases an unmistakable gap can be palpated between the fragments. This gap is increased by further flexion of the knee. Distension of the joint occurs rapidly and bruising over the fracture soon follows.

Radiograms are rarely necessary for diagnosis, but they should never be omitted as they may show comminution or co-incident injury, and they might be required later as legal evidence. It should be noted that the outline of the bones tends to be somewhat



blurred by the fluid in the joint.

*Treatment.*—Successful results will be obtained only if the injury is regarded as a ruptured quadriceps aponeurosis and treated as such. Conservative measures are at their best an unsatisfactory makeshift, and normal function can be secured only by open operation, the object of which is accurately to suture the torn aponeurosis. The operation, however, should not be undertaken lightly, a strict aseptic technique being of vital importance. I have seen

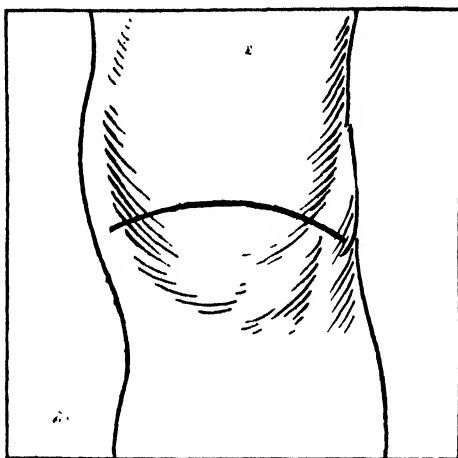


FIG. 5.—Incision for suturing ruptured aponeurosis and patella.

two cases of open wiring, done by occasional surgeons, which resulted in suppurative arthritis; one ended in bony ankylosis; the other had to be treated by amputation through the thigh, to prevent a fatal termination.

The best time for operation is between the fourth and seventh day, as the tissues have then recovered from the initial trauma, and ample time is provided for careful preparation of the skin. Local, spinal or general anæsthesia may be employed, according to the surgeon's preference.

*The operation.*—The best incision is one which is very slightly curved, with the convexity directed proximally, and at least four inches in length (Fig. 5).

The  $\cap$ -shaped flap incisions are out of date and unsatisfactory, as they do not provide adequate exposure of the aponeurotic tear. The entire length of the tear must be exposed, and the incision must be long enough to ensure this. The fracture site is opened up, blood-clot washed away, and aponeurotic fibres curled in between the fragments are excised thoroughly. The fractured surfaces must be completely exposed and any rough edges projecting backwards smoothed down with a raspatory or file. The knee is now fully extended, to relax the quadriceps, and the fragments drilled transversely, as far from the fracture as possible. They are now carefully and accurately apposed and coapted with phospho-bronze wire or kangaroo tendon, passed through the drill holes. If wire is used, the ends must be cut short and hammered into the lateral edges of the bone. Accurate fitting of the fragments ensures a smooth articular surface and prevents subsequent osteo-arthritis. The torn aponeurosis is then carefully sutured with interrupted catgut, throughout the whole extent of the rupture, at the sides as well as in front of the patella. The fascia and skin wounds are sutured separately.

Some surgeons ignore the fracture and content themselves with careful coaptation of the aponeurosis, while others merely encircle the fragments with strong catgut or kangaroo tendon. Fixation of the fragments in the manner just described, however, can do no harm, and by providing additional support, shortens the period of immobilization.

*After-treatment.*—After operation the limb is encased in close-fitting anterior and posterior unpadded plaster of Paris gutter splints. On the tenth day the skin sutures are removed and massage to the quadriceps may be commenced, the anterior gutter being removed for this purpose. At the same time the patella should be gently moved from side to side, to prevent adhesions to the femur. After the first fortnight the patient is

encouraged to walk in the plaster splints; this will preserve the function and nutrition of the joint and muscles, and prevent atrophy and stiffness. Gentle passive movements of the knee may be started after the third week, but active movements should not be commenced until after the fourth week, owing to the danger of re-fracture. Some limitation of flexion is to be expected for another month or two, and the surgeon must resist the temptation to hurry matters on by forcible exercises or manipulation.

*Results.*—Normal function may be expected in from three to six months. In old people some osteo-arthritis

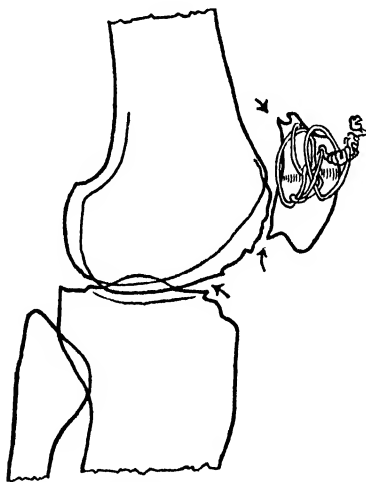


FIG. 6.—Radiogram showing osteo-arthritis after operation for fractured patella.

frequently follows (Fig. 6), but is very unlikely to do so if the fragments are fitted accurately together. Re-fracture is a distinct possibility if the fracture only is treated and the torn aponeurosis left unsutured. The writer has seen a case in which re-fracture occurred three times, each time a few months after wiring.

*Conservative treatment.*—The above treatment produces results far superior to the best that can be expected from conservative measures. If the aponeurosis is left unsutured, a certain degree of instability of the knee is inevitable; moreover, bony union of the

fracture hardly ever occurs. Conservative treatment should therefore be reserved for cases in which open operation is contra-indicated by age, infirmity or illness.

Blood and exudate must first be evacuated by aspiration. An attempt is then made to approximate the fragments and the aponeurotic edges with strapping, or preferably elastoplast, with the knee in full extension. The joint is then immobilized in this position in plaster of Paris gutters for at least four weeks. To minimize disability, side-to-side movements of the patella and massage to the quadriceps should be commenced after a week, and walking in the splints should be encouraged at the end of a fortnight.

Occasionally, a surprisingly good result is obtained. In old people the degree of disability is not great, provided the above precautions are taken. In young people, however, there can be no comparison between the results of conservative treatment and those of operation.

# Fractures of the Tibia and Fibula

By H. PLATT, M.S., F.R.C.S.

*Clinical Lecturer in Orthopædic Surgery, Manchester University ;  
Senior Surgeon and Surgeon-in-charge of Orthopædic Department,  
Ancoats Hospital, Manchester.*

## UPPER END OF THE TIBIA

**F**RACTURES of the tibial tuberosities.—These fractures, which are comparable in their mechanical after effects to fractures of the femoral condyles, may result from : (1) a compression thrust of the femur on the articular surface of the tibia sustained in a fall from a height ; (2) a powerful abduction or adduction strain of the knee ; (3) or more rarely, from direct violence. The fracture takes the form either of a vertical or oblique split running down from the joint surface, and cutting off the external or internal tuberosity, or a localized depression with comminution. The upper end of the tibia is broadened, and the plateau level is disturbed—a serious menace to the future of the knee-joint (Fig. 1). The clinical picture is that of a hæmarthrosis with an expansion of the upper end of the tibia ; there may be a definite block to extension if the tibial spine is also detached.

Prompt reduction of the displacement is essential ; the level of the tibial plateau must be restored, and a right of way secured for full extension. This is usually possible by manipulation and traction combined with a squeezing together of the tuberosities. Reduction is followed by a period of immobilization with traction on a Thomas splint. Active movements of the knee should be allowed after the third week, but weight-bearing should not be permitted before the eighth week. If accurate replacement cannot be achieved by con-

servative methods in patients in the prime of life, the affected tuberosity should be fixed by means of an ivory or "beef bone" peg. In old and feeble individuals who not uncommonly sustain this type of fracture, it may be necessary to rest content with imperfect correction. Failure to restore the level of the tibial articular surface means the certain development of arthritic changes in the knee-joint.

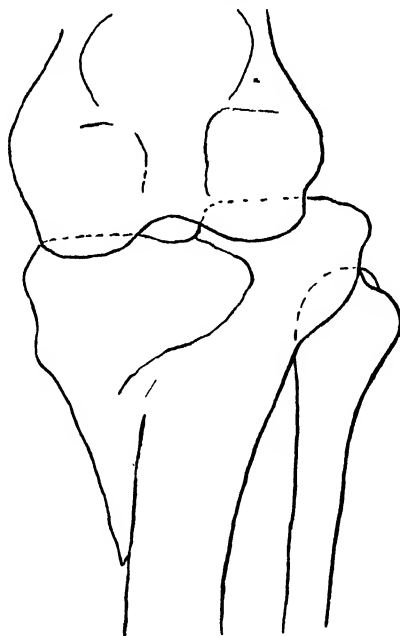


FIG. 1.—Fracture of internal tuberosity of tibia with marked disturbance of the tibial plateau.

*Fractures of the tibial spine.*—Three distinct types of this uncommon but important injury have been distinguished (Jones and Alwyn Smith<sup>1</sup>):—(1) *Avulsion of the inner tubercle of the spine*, following a forcible hyperextension of the knee, a mechanism which more commonly produces the equivalent lesion of rupture of the anterior crucial ligament. The small bony fragment is usually displaced forwards, and at once forms a block to complete extension, which accounts for the characteristic clinical sign. The knee-joint

rapidly fills with blood and effusion, and careful testing may demonstrate abnormal hypermobility of the tibia on the femur in the antero-posterior plane. The diagnosis is made certain by a radiographic examination. The obstacle to extension should be overcome by manipulation and the joint completely immobilized for not less than four to six weeks. During this time, as in all severe knee injuries, the quadriceps tone should be maintained by faradic stimulation and massage. When repair is considered to be sound, gradual mobilization of the knee by the active efforts of the patient is instituted. Any residual limitation of mobility at a later stage can be dealt with by a judicious manipulation under anæsthesia. In neglected cases where the bony block persists, the knee-joint should be explored and the obstruction removed.

(2) *Fracture of the outer tubercle*, a rare injury, is produced by the impingement of the inner margin of the outer femoral condyle on the tibial spine during a forced abduction of the knee in which the internal lateral ligament has been severely overstretched. The characteristic sign is again a blocked extension.

(3) *Fracture of the tibial spine* associated with fracture of one of the tibial tuberosities (*see above*).

*Separation of the upper epiphysis of the tibia*.—This unusual injury is sustained by children between the ages of three and nine. The epiphysis is wrenched off and displaced forwards. Reduction is an easy matter soon after the accident, and there is little tendency to redisplacement with the knee maintained in extension. After a delay of some days it may be difficult to correct the displacement fully, and the position of flexion of the knee is likely to be required for the first ten days. Disturbance of growth, giving rise to shortening and deformity, is a possible sequel.

#### UPPER END OF THE FIBULA

Two types of fractures are encountered at this level—

both comparatively uncommon injuries.

(1) *Traction fracture of the styloid process.*—The fibular styloid, or a more considerable fragment, carrying with it the insertions of the biceps tendon and external lateral ligament of the knee, is sometimes detached by a forced adduction (Figs. 2 and 3). This fracture may occur alone, or may accompany a dislocation of the knee-joint. Its importance lies in the fact

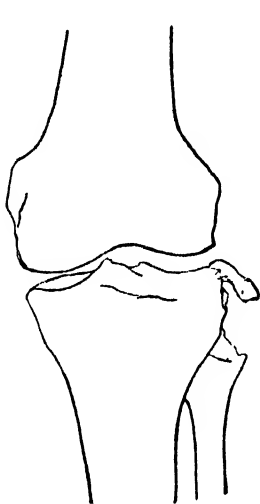


FIG. 2.—Traction fracture of upper end of fibula, with external popliteal nerve involvement.

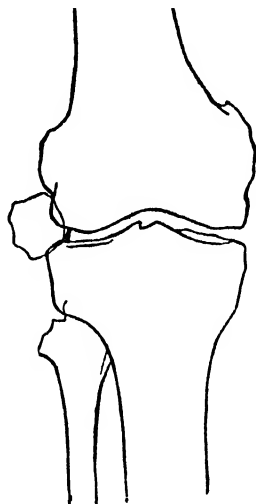


FIG. 3.—Fracture of upper end of fibula with external popliteal nerve involvement.

that the external popliteal nerve rarely escapes damage. The nerve trunk is either stretched or torn completely across (Platt<sup>2</sup>). The bony fragment is drawn upwards by the pull of the biceps, and may even enter the outer part of the knee-joint (Watson Jones<sup>3</sup>). Replacement by manipulation alone is rarely practicable. The bony fragment should be exposed and reattached to the head of the fibula. At the same time the external popliteal nerve should be inspected, and any necessary repair carried out.

(2) *Fracture of the neck of the fibula.*—This is a trivial injury. The line of fracture is usually transverse and there is little or no displacement. Involvement of the



external popliteal nerve is rare. The disability is insignificant; immobilization is unnecessary, and walking may be allowed within a few days.

#### SHAFT OF TIBIA AND FIBULA

*Fibula.*—Isolated fractures of the shaft of the fibula are uncommon and unimportant. Displacement is slight or absent, and the clinical signs suggest little more than a simple contusion. Strapping or a light ambulatory plaster should be applied, and weight-bearing allowed after a few days.

*Tibia.*—Fracture of the tibial shaft is a common injury in children and young adults. The oblique or spiral fracture of the mid-shaft resulting from a torsion violence is the predominating type. As the fibula remains intact, the displacement is often small, but occasionally in the adult considerable overlap and angulation may develop. In these circumstances the intact fibula may hinder accurate reduction.

In the majority of cases where the displacement is negligible or easily corrected, the fracture can be effectively controlled in an accurately fitting plaster of Paris cast extending from the toes to the mid-thigh. An iron stirrup should be incorporated in the lower part of the plaster on which weight can be borne with comfort at the end of a week. In the average case union is seen in from four to six weeks; in older people union may be slow.

Where the initial displacement tends to recur and the upper fragment projects dangerously beneath the skin, open reduction and fixation are indicated, the fracture being secured by a Lane steel plate adjusted to the natural tibial curve.

*Combined fracture of the tibia and fibula.*—These injuries are familiar at all age periods. The common site of fracture is at the junction of the middle and lower thirds. When produced by direct violence the bones break at the same level, and usually with com-

minution. In the considerable number of fractures due to lateral bending or a torsion force, the fibula gives way at a higher level. Displacement of various types may be seen; forward projection of the upper tibial fragment; external rotation of the lower fragment, combined with overlap and angulation are characteristic.

*Treatment.*—Early reduction is important in healthy, muscular adults. After a few days' delay displacement and shortening increase, and the infiltration of the non-extensile fascial compartments of the leg adds to the obstacles to reduction. Transverse fractures are usually easy to reduce and control, but spiral fractures offer considerable difficulty. It is essential to remember that the correct alignment of the leg implies the preservation of the normal degree of outward bowing. A common error is to "set" the fracture in a straight line.

Fractures with little displacement may be treated by fixation in plaster of Paris, and early weight-bearing allowed on a stirrup. Where there is overlap or other deformity, traction is essential on a Thomas splint with the knee in flexion. If considerable force is required, or if the condition of the skin is doubtful, skeletal traction by means of a pin through the os calcis must be employed. Sound union of the fracture is rarely obtained before the eighth to the tenth week, and is encouraged by weight-bearing in an ambulatory plaster.

Operative reduction in spiral fractures at the lower third of the leg is occasionally necessary if strong traction fails to restore accurate alignment. The wider use of skeletal traction has materially diminished the number of fractures requiring internal fixation.

In compound fractures immediate and judicious excision of all damaged tissues must be carried out; extension is usually necessary, and is best obtained by continuous traction on a transfixion pin through the os calcis. At the end of five to seven weeks' extension, weight-bearing in a well-fitting ambulatory plaster

of Paris cast can be allowed.

#### LOWER END OF TIBIA AND FIBULA

The great majority of these injuries are produced by indirect violence represented by a forced movement of the foot on the leg—external rotation 61 per cent., abduction 21 per cent., or adduction 13 per cent.

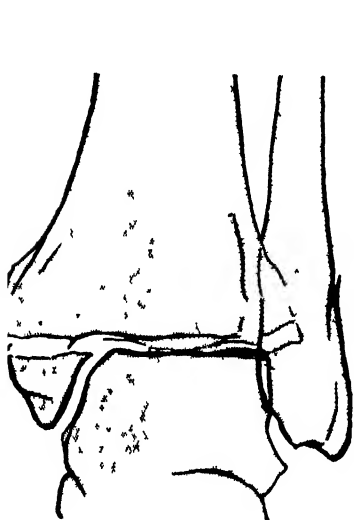


FIG. 4.—External rotation fracture. Anteroposterior view. Note the separation of the internal malleolus. The fibular fracture is scarcely visible.

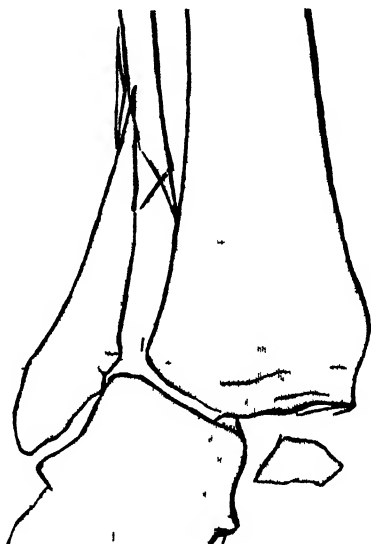


FIG. 5.—Abduction fracture. The fibular fracture of the "bending" type is unusually high. There is an accompanying diastasis.

(Figs. 4 and 5). The resulting fractures fall into three groups: (1) Isolated fractures of the external malleolus; (2) isolated fractures of the internal malleolus; (3) the most important group of all, fractures of both bones, which form some 50 per cent. of ankle fractures as a whole. The latter group comprises the classical Pott's, or more correctly the Pott-Dupuytren fracture, in which there is a disturbance of the mechanics of the ankle joint (Figs. 4 and 5). In these the fibular fracture is the pivotal injury, and is combined either with a fracture of the internal malleolus or rupture of the internal lateral ligament. In 20 per cent. of Pott-

Dupuytren fractures a third fracture is present—the posterior marginal fracture of the tibia produced by an upward compression thrust of the astragalus (Fig. 6).

The isolated fractures of the malleoli rarely show any appreciable clinical displacement, and the same is true of a considerable proportion of fractures of the Pott-Dupuytren type. Gross displacement is seen in some 25 per cent. of all ankle joint fractures. The characteristic deformity is eversion, with or without backward displacement of the foot. The latter deformity occurs

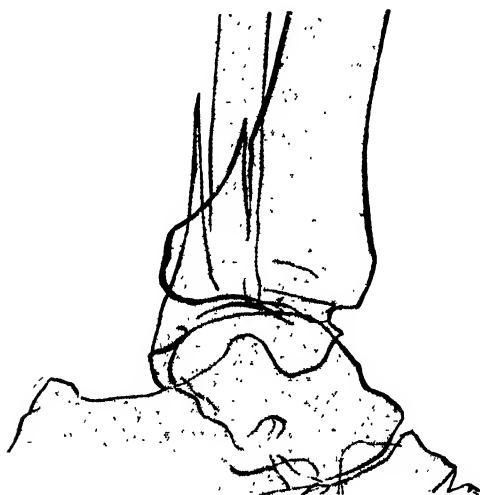


FIG. 6.—External rotation fracture. Lateral radiogram showing the oblique fracture of the fibula and a posterior marginal fracture of the tibia.

where there is a posterior marginal fracture, or a separation of the two bones at the inferior tibio-fibular articulation.

*Treatment.*—(1) *Recent fractures*: Reduction of the displacement should be carried out without waiting for the swelling to subside. After flexing the knee the heel is pulled forwards and the foot inverted. Pressure is then made on the malleoli to overcome any widening of the ankle mortise. In the classical fracture-dislocation with considerable displacement reduced within a short time of the accident, the bones often lock in

position, and there is little tendency to recurrence of deformity. There is only one effective method of controlling an ankle fracture, and this is an accurately-fitting plaster of Paris cast. The cast should be removed at the end of three weeks, and an ambulatory plaster with a stirrup attached, or of the Delbet type, should be applied. Weight-bearing with the fracture carefully controlled in this fashion should be permitted from the third to the sixth week, according to the degree of the original displacement. After removal of the plaster a zinc-gelatine bandage, extending from the knee to the toes, is worn for two to four months in order to check the œdema which is commonly a troublesome sequel. In addition, the heel of the shoe is elevated on the inner side, and in heavy individuals an outside steel and T-strap give support and comfort.

In isolated fractures of the malleoli and combined fractures without displacement, the patient may be allowed to bear weight in an ambulatory plaster after a few days.

(2) *Old fractures*: Malunion with deformity is not uncommonly seen in fractures of the Pott-Dupuytren type owing to ineffective reduction or omission to guard the fracture during the early stages of weight-bearing. In patients of suitable age and physique, operative correction of the malunion should be undertaken. In a deformity of a few weeks' standing, the line of fracture should be cut through and the displacement corrected. In a long-standing deformity the choice lies between a reconstruction of the fracture and arthrodesis of the ankle joint.

### References.

<sup>1</sup> Jones, Robert, and Smith, Alwyn: *Brit. Journ. Surgery*, 1913, i, 70.

<sup>2</sup> Platt, H.: *Journ. Bone and Joint Surgery*, 1928, xx, 403.

<sup>3</sup> Watson Jones: *Journ. Bone and Joint Surgery*, 1931, xiii, 258.

# Injuries of the Foot

By WALTER MERCER, M.B., F.R.C.S.E.

*Lecturer on Clinical Surgery, Edinburgh University; Assistant Surgeon to the Royal Infirmary, Edinburgh; Surgeon to the Chalmer's Hospital, Edinburgh.*

IT is not only true that fractures of the bones of the foot are the most frequent of all fractures, but it is also, unfortunately, true that they are the most commonly undiagnosed. The Industrial Commission of Ohio reported in 1926 that out of a total of 4,473 fractures, no fewer than 1,349 affected the foot bones, i.e. more than 25 per cent. of the total. Bacon, in reviewing the economic aspect of 3,473 fractures of all kinds, stated that, as regards total expense due to loss of time, fractures of the metatarsals, metacarpals, and phalanges of both extremities are more serious than all other fractures combined.

Unfortunately, it is little realized how easily the foot bones may be fractured. The 5th metatarsal may be broken by a mere lurch of the foot while dancing, or by operating the kick-start of a motor cycle. The calcaneus and talus are commonly injured by falls from a height; the height need not be great, the important factor rather appearing to be the alighting on the foot with the leg rigidly extended. Forcible and extreme movements cause sprain fractures, while direct violence, as when a heavy weight falls on the foot, is most likely to affect the metatarsals. The calcaneus, however, may suffer from the same type of violence, as in the "inching" fractures, where the wheel of a motor car, quick off the mark when the green light shows, shears off the posterior part of this bone in a slow moving pedestrian.

The failure to recognize such fractures may be due to: (1) The considerable swelling that accompanies not only fractures, but also severe sprains and strains,

and which renders palpation of the bones difficult. (2) The absence of superficial bony points that might help in the diagnosis. (3) The frequency with which the patient is able to bear at least some weight on the affected member. (4) Perhaps to some extent the fact that students are taught that foot fractures are easily recognized.

A high degree of disability frequently results from foot fractures, and this is not difficult to understand when the anatomy of the foot is considered. The dove-tailed fitting of the small bones, their close ligamentous connections, and the series of arches which are formed in the foot, all constitute difficulties which must be overcome in accurate reduction of fractures.

In view of the difficulty in recognition and of the severe disability that may result, it is superfluous to suggest that every foot injury, however trivial it may seem, should be X-rayed at the earliest possible moment. If no bone lesion is found, no harm has been done; but if a fracture is discovered, a lifetime of misery and crippling pain may be avoided by the early institution of treatment.

Many of these foot fractures are exceedingly difficult to reduce by manipulative methods, and it will be found better to enlist the services of a skilled operating orthopædist in the majority of cases, if a serviceable foot is to be the outcome.

*Diagnosis.*—It is of the utmost importance that a diagnosis be reached at once, and, despite the fact that the bones are superficial, this is never easy. Stern has called attention to three important points:—

(1) Sharp localized pain over the bone, easily demonstrated by palpating the bone with the rubber end of a lead pencil, and hence called “pencil tenderness.”

(2) Local swelling, confined more or less to the area of tenderness.

(3) Local discoloration, from hæmorrhage in the

same area.

These signs appear in the above order, the third being late; indeed, the diagnosis should be made before it appears.

The importance of X-raying the part in various planes cannot be over-estimated. The radiograms, of course, should be taken and interpreted by an expert, and even he should have at hand corresponding films of the normal foot for comparison.

#### FRACTURE OF THE TALUS

Fracture of the talus alone is rare, but it occurs not infrequently in association with fracture of the

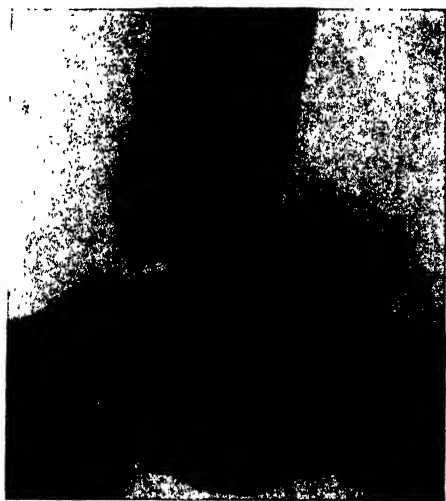


FIG. 1.—A lateral view of the fracture-dislocation of the talus.

calcaneus, of the fibula, or with a dislocation of the ankle joint. The lesion in the talus is usually a crush fracture; it may be produced, along with its associated injuries, by forcible dorsiflexion of the foot or by a fall. The fracture may be said to involve either the neck, the body, or the posterior process. The latter, however, may be dismissed in a word, since in most cases it is not a fracture but a non-union of the secondary centre for the posterior process—the so-called os



trigonum tarsi. When there is a definite fracture, the treatment is simple, consisting of rest in bed for 10 days, with massage and early active movements.

Fractures of the body are usually comminuted and compressed, but marked displacement is rare. The neck of the talus is weakened by the presence of many nutrient foraminæ and is susceptible, therefore, to mild degrees of violence. Fractures are produced by a fall while the foot is in a dorsiflexed position, the neck being nipped between the anterior edge of the tibia and the calcaneus. If the violence is excessive, the body of the talus may be expressed backwards, and, en route, may splinter the posterior aspect of the tibia. In its further progress, it impinges on the tendo Achillis and is rotated medially and vertically, so that the trochlear surface faces inwards and the fractured surface downwards.

*Symptoms.*—In the absence of displacement, the symptoms of fracture are swelling about the ankle joint, tenderness in the region of the fracture, pain on weight-bearing, and on flexion of the foot. When the body is compressed, there is some loss of contour of the ankle, marked limitation of movement, and the malleolar tips appear to be at an abnormally low level.

The chief immediate symptoms are thus similar to a Pott's fracture, but the deformity differs in that there is an irregular filling up of the hollows on either side of the tendo Achillis. This may be more accentuated on one side or the other, and the tenderness is over the talus and not the malleoli. Crepitus is usually absent. The foot is held in the plantar flexed position to relax the tendo Achillis, but there appears to be little tendency to either valgus or varus deformity.

The fracture may easily be rendered a compound one through pressure-necrosis of the skin overlying the fragment. The outlook then immediately becomes more serious. The injury is very commonly overlooked,

even when good X-rays are available, but a consideration of the mechanism of the injury and the clinical findings should rouse suspicions of such a lesion. Where displacement exists, the injury is a serious one, and permanent disability is apt to result, especially if the error is not reduced early.

*Treatment.*—If there is no displacement, a plaster of Paris case is applied from the toes to just below the knee, with the foot at right angles to the leg and slightly inverted. After two weeks the case may be bivalved and massage and active movements instituted, but weight-bearing should be prohibited for six weeks and only allowed then if the arches of the foot are properly supported. Sponge-rubber arch supports are best; they are inserted into the boot, and are worn for three to six months.

The consensus of opinion concerning fracture-dislocations of the talus is that while it may be possible to reduce the error if it is recognized within a day or two of its occurrence, in late cases the best treatment is to remove the displaced fragment.

Under a general anæsthetic, traction is put on the foot with the ankle joint and the knee flexed to right angles to relax the tendo Achillis and open up the space between the tibia and calcaneus for the reception of the displaced fragment. This may be manipulated back into its normal site by finger and thumb, and, if it proves stubborn, further flexion of the foot will enlarge the available "socket." Should this manœuvre not be successful—and it becomes increasingly difficult with every hour of delay—further attempts should be postponed until the skin of the foot and of the leg is in a suitable condition for operation.

To achieve replacement of the fragment, it seems hitherto to have been considered necessary to carry out a tenotomy of the tendo Achillis. The present writer considers, however, that the necessary relaxation can be adequately secured by flexion of the knee.

If this position does not permit of replacement, then open reduction should be attempted.

A lateral J-shaped incision, passing down the back of the fibula and turning forwards below the lateral malleolus, gives a good access to the fragment and avoids any operative trauma to the important structures on the medial side of the Achilles tendon. If reduction is unsuccessful, then the fragment should be excised. There appears to be no necessity to remove the head and neck of the talus, as their retention does not produce any foot deformity.

After removal of the fragment, a few days of absolute immobility are essential; massage and active and passive movements are then instituted. During the convalescence a lateral iron and a medial T-strap are important adjuncts to the treatment as they prevent any tendency there may be towards a lateral deformity.

#### FRACTURE OF THE CALCANEUS

Fractures of the calcaneus are the most frequent of the tarsal fractures, and where—as is usual—they are associated with displacement, poor functional results are the rule. As there is a consequent marked decrease in the earning capacity of the individual, these fractures are of distinct economic importance.

An avulsion fracture of the posterior portion and a fracture of the sustentaculum tali from forced inversion of the foot are comparatively rare. The avulsion type frequently requires open operation to secure replacement of the fragment, but thereafter the treatment is straightforward and the outlook good.

When the sustentaculum tali is fractured, there is frequently an associated injury of the spring ligament of the foot, so that, in the after-treatment, the greatest care is necessary to prevent a flat foot. Under anaesthesia the arch of the foot is carefully moulded into shape and, with the foot inverted and at right angles to the leg, a plaster cast is applied to support, in

particular, the long arch. The plaster is bivalved in two weeks and massage commenced, but weight-bearing is not permitted for six weeks. Thereafter the arch is supported for some months.

*Fracture of the body of the calcaneus.*—A fall from a height, by driving the wedge-shaped inferior surface of the talus into the body of the calcaneus, may fracture the latter in a longitudinal or a transverse direction. Comminution and compression usually result, so that the bone widens, often to twice its normal width. There are frequently other displacements in the vertical and horizontal planes. Since

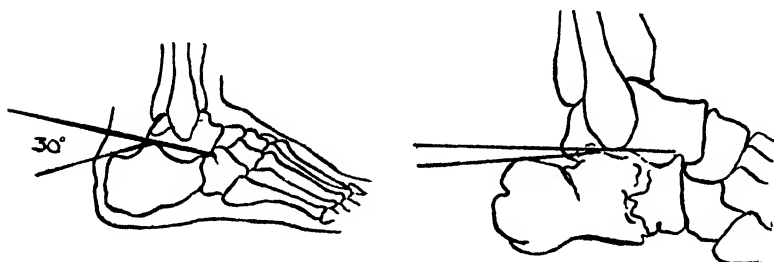


FIG. 2.—(a) Normal radiogram of the calcaneus, showing the angulation between the line joining the posterior process and the highest point of the articular surface and the line joining the latter point to the anterior articular surface. This is normally 30°.

(b) Shows the effect of a crushing fracture, where the angulation is almost obliterated.

the body weight is normally transmitted through the medial side of the bone, the inferior and lateral portion is usually displaced upwards and outwards, thus producing an excess of bony tissue under the external malleolus.

*Symptoms.*—There is marked swelling about the ankle, particularly in the region of the malleoli and behind the mid-tarsal region. Flexion and extension of the foot are remarkably free, but lateral mobility may be completely abolished or, at least, greatly limited, and accompanied by pain. Crepitus is often present. Viewed from behind there is a characteristic broadening of the heel below the malleoli, and the

malleoli are seen to be on a lower plane than normally.

*Diagnosis.*—Although the patient is often able to bear some weight on the foot, a fracture must be suspected in the presence of localized pain and tenderness, broadening below the malleoli, and limitation of lateral movement. A radiogram will readily prove the presence of a fracture. In a lateral view of a normal foot the angle between the line extended through the upper articular surface of the bone and the upper surface of the tuberosity, and the line joining the anterior and posterior extremities of the articular surface is about  $30^{\circ}$ . After a compression-fracture this angle is considerably reduced or may be altogether absent, since the tuberosity may be higher than the articular surface.

*Treatment.*—Reduction of the displacement should be attempted under an anæsthetic. It is a difficult problem, however, and, as would be expected, many methods have been advocated. The chief deformities to be considered are the upward displacement of the posterior fragment and the broadening of the subtaloid portion from compression.

The upward displacement is maintained by the contraction of the calf muscles. At the onset, therefore, these muscles are relaxed by flexing the knee and by plantar flexing the foot. In this position an attempt is made to reduce the broadening of the body of the bone. Cotton advises pounding the heel with a sandbag, while Böhler uses a special *redresseur* which, by means of a screw, produces great lateral compression. Both methods inflict a considerable degree of trauma on the soft tissues, the one by the hammering, and the other by the slowness of the compression, which damages the blood supply.

The present writer employs the following method, which he believes is an improvement on the two above described: Under a general anæsthetic the foot and leg are prepared as for an open operation. The knee

is flexed over the end of the operating table, which is elevated to its full height. A fairly strong metal pin is then inserted through the posterior fragment, and to its projecting ends a loop of rope is attached. To reduce the upward displacement of the posterior fragment, strong traction is exerted by means of the operator's foot inserted through the loop. A special



FIG. 3.—The method of reduction of a fracture of the calcaneus.

instrument, which is fashioned on the lines of the osteoclast but with special rubber-covered wooden pads, which in the normal foot would fit into the depression below the malleoli, is then employed. The wooden pads are applied, one on each side of the heel, opposite the widened bone, and the handles firmly brought together. The advantage of this instrument is that, while the long handles permit of any degree of compression necessary, that compression is momentary, and therefore less devitalizing to the soft tissues than the screw.

When the normal contour has been restored by this means, and the displaced posterior fragment replaced by traction, a plaster of Paris case is applied over sterile dressings to the leg from the foot up to the mid-thigh, with the knee flexed to a right angle and the foot just plantar flexed. The pin is incorporated in the plaster and left in position until the plaster is removed in about four weeks' time.

A lateral X-ray is taken immediately after reduction, but it is usually possible to be reasonably certain of success at the time of manipulation if the broadening has been obliterated and full traction applied to the pin. A certain degree of adduction of the foot can be secured before the application of the plaster by exerting a slightly greater pull on the outer part of the extension pin.

On the removal of the plaster in four weeks, the pin is extracted and a sterile dressing is applied to the resultant wounds. An elastoplast bandage is then applied from the toes to below the knee, to dissipate or prevent œdema. Active movements are encouraged, and the patient is allowed about on crutches. No weight-bearing is permitted for ten weeks, and then only if the patient can wear shoes. These are built to produce a little deviation, usually inwards, i.e. in adduction, although it will occasionally be found that the patient is more comfortable with an outer raising to the heel, producing abduction. Several adjustments should be tried, and the one which suits the patient best retained. An inserted instep support of sponge rubber is also fitted to the shoe.

*Treatment of mal-union.*—Unfortunately, many of these fractures resist manipulative reduction, and many more are unrecognized, both by the patient and by the doctor, and so it is common to see in consultation old unreduced fractures with broadening of the heel, limitation of movement, flat foot, and great pain on weight-bearing. Such severe disabling effects can

only be alleviated by operative means, since tilted heels, arch supports, and other conservative measures rarely produce benefit.

The exact details of the necessary operation vary to some extent with the type of displacement, but in general the principal step of the operation is a subtaloid arthrodesis. The adjacent surfaces of the calcaneus and talus are removed, along with their interosseus ligaments, and it is usually necessary to make the upper surface of the calcaneus slope upwards and backwards to correct as far as possible the upward displacement of the posterior portion. Bony masses impinging on the external malleolus should be removed and, if the radiogram shows calcanean spurs, these also should be excised.

The post-operative treatment is that of a fracture. The foot is put up in a plaster cast for five weeks, after which elastoplast bandages, massage, and suitable foot wear are employed.

#### NAVICULAR AND OTHER TARSAL FRACTURES

Fractures of the remaining tarsal bones are rare, and consequently of less importance than those of the calcaneus and talus, although they too may result in long standing disability. The navicular may be fractured by direct violence, and the lesion is often associated with fractures of the other bones of the foot. A fracture may result from a fall on the foot, the bone being crushed between the talus and the internal cuneiform. The insertion of the tibialis posterior into the navicular explains those avulsion fractures in which the tubercle is torn off. Usually there is some displacement of the fragments, and some localized pain and tenderness, the former being increased on attempted weight-bearing. Local swelling and ecchymosis is evident and the foot is held in an abducted position. In viewing the radiogram, the sesamoid bone occasionally present in the tibialis posticus should not



mislead one into assuming the presence of a fracture.

*Treatment.*—When there is no marked displacement, a plaster cast should be applied to the inverted and adducted foot for four or five weeks. Weight-bearing should be prohibited for five to ten weeks and thereafter a properly adjusted shoe should be worn. The presence of a complicating displacement demands open operation, with reduction, or partial excision of the fragments and arthrodesis followed by plaster immobilization.

Occasionally chip fractures of the cuboid or internal cuneiform are found, often long after the original injury. These are often accompanied by severe injury to the soft structures and result in flattening of the arch of the foot. They are usually notable for the amount of œdema which results, and in its presence a guarded prognosis should be given, as frequently, although little is to be seen in the X-ray, it may be many months before the patient is able to resume his work. The main feature of the treatment is to immobilize the foot for two or three weeks in a position in which there is least tension on the important plantar ligament—i.e. in adduction and inversion.

#### FRACTURES OF THE METATARSALS AND PHALANGES

Fracture of one or more of the metatarsal bones is a fairly frequent injury. It may be the result of direct violence, as from falling objects, or less frequently from indirect violence, such as the sudden impact of the body weight on the toes, as in jumping or running, or even a misstep in dancing. There is usually considerable bruising of the overlying soft parts, with swelling, pain, tenderness on pressure, and ecchymosis. It is frequently possible to detect crepitus, and the fragments may be moved on palpation. Multiple fractures are frequent.

Fractures of the fifth metatarsal are particularly common and are produced by direct pressure on the

outer part of the foot in the position of inversion. Fractures of the second metatarsal usually occur at the neck of the bone, frequently in soldiers, and hence called march fracture; this is of the nature of a pathological fracture. There is primarily a falling of the anterior arch, with a secondary spasm of interossei muscles which inhibits the blood supply to this bone. As, when the anterior arch has fallen, the second is the longest metatarsal and bears most weight in stepping

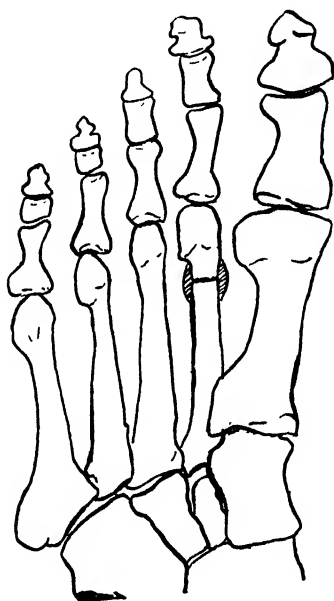


FIG. 4.—Line drawing showing the appearance of a March fracture.

forward, it may happen that the bone cracks at the neck even with the slight trauma of ordinary walking.

*Treatment.*—In most cases where a single metatarsal is involved, there is little tendency to displacement. Many such cases, therefore, require no further treatment than a plaster of Paris case from the toes to just below the knee joint. The foot should be slightly inverted, at a right angle to the leg, and with the arches of the foot amply supported. In ten days' time the case may be removed and massage and active movements of the various joints started. Union should be

firm in about five weeks, and weight-bearing may be permitted in six weeks. A suitable appliance should be placed in the walking shoe to support the arches during the convalescent period. In fracture of the base of the fifth metatarsal, where the fragment is avulsed, prolonged pain and disability are avoided by tacking the avulsed fragment back into place.

#### TREATMENT OF MULTIPLE FRACTURES

In the treatment of multiple fractures it is important to secure reduction as far as possible, or, at any rate,

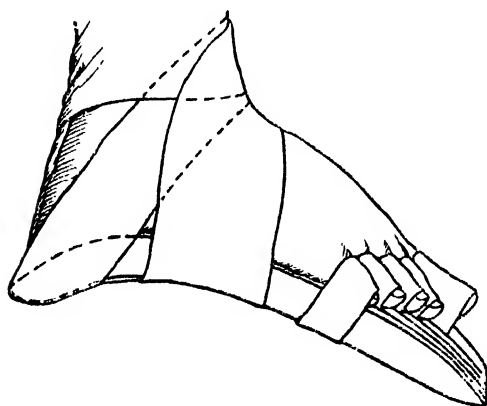
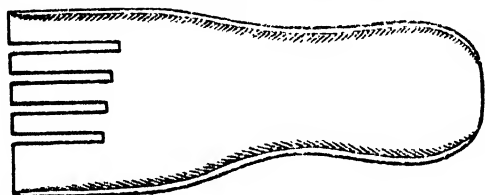


FIG. 5.—Modification of the Davis splint for multiple fractures of the metatarsals.

to prevent any possibility of plantar angulation of the fractured shaft, since this is so apt to cause in the future painful pressure points on the sole, or even metatarsalgia. To be effective, treatment should

consist of adequate preservation of the normal arch of the foot, should hold the foot in inversion, and should secure traction on the forefoot.

For such fractures the splint developed by Davis is most useful. It is made of duralmin and is somewhat similar in shape to the sole of the foot; it therefore curves upwards into the plantar concavity of the foot. Its anterior end is divided into five separate compartments for the toes. The toes having been strapped in their respective places, the forepart of the foot is firmly bound to the splint by adhesive tape and gauze bandages. The splint is then sharply forced forwards and fastened in position by bandages and adhesive tape which pass under the heel portion and across the front of the ankle-joint. The traction thus exerted stretches the capsule and the ligaments, and prevents plantar angulation of the fractured shaft.

The splint is retained for two or three weeks during which time the patient gets about on crutches. After it is removed, a good deal of the swelling which results from the dependent position of the foot may be prevented by the application of a zinc gelatine bandage. Massage and radiant heat are applied after removal of the splint, but it is unwise to allow weight-bearing or at least six weeks. During this time the foot gear of the patient should be overhauled and the shoes fitted with a sponge rubber support for both the long and anterior arches of the foot. A three-sixteenth-of-an-inch wedge to the inner side of the sole is also valuable in preventing any later static trouble.

# Sports Injuries and their Treatment

By C. B. HEALD, C.B.E., M.A., M.D., M.R.C.P.

*Physician in charge of Electro-therapeutical Department, Royal Free Hospital; Consultant in Electro-Therapy to the Royal Air Force.*

A MAN or woman who can enjoy a strenuous day's sport—hunting, for instance—relies upon six principal factors : (1) the integrity of his framework, e.g. bones and ligaments ; (2) the potency of his power unit, e.g. both the tone and the contractile power of his muscles ; (3) the adequacy of his lubrication system, e.g. synovial membranes and bursæ ; (4) the elasticity of his scavenging system, e.g. lymph channels and glands and skin. In addition to these four main systems he depends also on the efficiency of his co-ordinating supply services, e.g. blood and nerves ; and to a lesser extent, for protection, on the condition of his skin.

When dealing with any injury of sport it is essential to realize the independence and interdependence of each of these systems. A breach of the framework—such as a fracture—may, and as a rule does, become the principal factor influencing treatment, but at the same time that the bone breaks the power unit of the part loses efficiency, the lubricating system tends to stagnate and the drainage system is seriously impaired. The main injury, on the other hand, may affect a muscle or its tendon while the framework escapes : rider's strain, for example. An injury of this kind demands just as great attention to the other services : not only attention to any possible damage that they may have sustained at the time of the accident, but attention during the process of repair, so that treatment considers their needs, and the advance towards recovery is uniform at all points.

If the practitioner bears in mind the importance of

these main systems and of the patient's general health, and at the same time remembers the auxiliary systems, he will be able to diagnose more easily and treat more intelligently. Unfortunately there are some conditions, such as dislocation of the elbow and fracture of the scaphoid, where the welfare of all the systems cannot be pursued simultaneously and one must be sacrificed to another. A long period of immobilization involves considerable debility of the power unit and stagnation in the oiling and scavenging systems. These can generally be restored later, but allowance for their subsequent treatment must be made in the prognosis.

#### DIAGNOSIS

(1) *The framework*.—The signs of loss of integrity in the bones and ligaments are classical: pain, loss of function, deformity, crepitus. Their recognition, together with the use of X-rays, requires no discussion. When the practitioner is doubtful whether or not he ought to have an X-ray, it is worth remembering that pain which is sudden, sharp, localized and brief always strongly suggests bony injury. Pain due to damage of other tissues tends to build up more slowly, to linger, and to radiate or shoot away from its point of origin.

(2) *The power unit*.—Gross interference with the power unit—for instance, complete rupture of the biceps, quadriceps or adductor longus—is always so obvious as to present little or no difficulty in diagnosis. There is a gap in the muscle, a hæmatoma and loss of function. On the other hand, the diagnosis of strains that have probably torn a few fibres of muscle and tendon is not always easy. There are, however, certain helpful guides:—

(i) Muscle-fibre injury is suggested by (a) cramp-like pain localized over a muscle-belly, coming on rather slowly and passing slowly away; (b) a heaviness or tired pain increasing with voluntary movement or effort and also localized over a muscle-

belly.

(ii) Muscle-belly injury is suggested when the pain of voluntary movement is diminished by support or partial fixation of the suspected muscle group near its tendon. If this support increases the pain, the condition is probably either a tendon injury or tenosynovitis.

(iii) Injury to a tendon or its insertion is suggested when voluntary movement is painless over a limited range and then becomes painful and increases as the movement is completed.

Disturbance of muscle tone can be detected by two rapid tests which have been used for years in the Royal Air Force, especially after minor crashes :—

(a) The splashing stomach test : The patient lies flat and relaxed and the examiner rocks the anterior abdominal wall with his hand. If there is a splashing like that produced by shaking a half-filled bottle, tone is certainly poor. If the splashing is heard at first but diminishes when the rocking is continued, tone is disturbed but not lost.

(b) The jugular vein test : The patient again lies flat and relaxed and the examiner presses firmly down on the abdominal wall. If the external jugular veins immediately fill out and bulge, the vascular and muscular tone is certainly poor.

(3) *The lubricating system*.—There are some definite “snags” in the examination of this system.

Wash-leather creaking is the classical sign of tenosynovitis, but this condition may be present without creaking, and creaking may be heard when the lesion is a tendon injury or a bony fracture. A swelling near a joint may be due to effusion into the joint capsule or part of some bony injury near the joint. Here, again, there are some helpful guides :—

(a) The patient with tenosynovitis or synovitis of a joint complains of a discomfort on palpation which is uniform in intensity over a limited area and then stops

suddenly at a line which corresponds closely with the anatomical surface-marking of the tendon sheath or joint. The pain of tendon or bone injury has a spot of maximum intensity but tails off gradually and irregularly and does not cease at any anatomical boundary.

(b) In tenosynovitis voluntary movement of the corresponding muscle causes an even increase of pain which is made worse if the movement is resisted and reduced if the painful area is supported in a light but firm grasp.

(c) Uncomplicated tenosynovitis usually comes on slowly, in the evening after a game, whereas tendon injury makes itself manifest almost at once.

(d) Bursitis is characterized by a pain near to but outside a joint. The patient at first has difficulty in demonstrating or reproducing his pain; it catches him unawares and suddenly inhibits muscular action, passing off with equal suddenness. The bursæ most often affected in sport are the sub-deltoid, biceps cubitus, gluteus medius and semi-membranosus bursæ; and they need especial care in diagnosis and treatment.

(4) *The scavenger system.*—Gross defects in this system are easy to recognize: e.g. œdema, bogginess, large and tender swollen glands. Minor defects are, however, not so easy to recognize, largely because little attention has been paid to the importance of this system. The drainage is not adequate if a part feels larger than it should do to the patient, and particularly if it “squeaks” or “creaks.” A part inadequately drained also has a curious dead, chilly, toneless feeling.

#### TREATMENT

(1) *The framework.*—Injuries to bones and ligaments are dealt with elsewhere in this issue, and it is sufficient to remember that:

(a) Repair takes place through the agency of imported primitive blood cells; therefore, the injured part must be kept well nourished with blood.



(b) Functional recovery is in direct proportion to anatomical reconstruction.

(c) Mobilization and immobilization can both be overdone; excessive use handicaps repair to the framework, and prolonged disuse hinders the recovery of the power unit and the oiling and drainage systems and causes unequal functional recovery.

(2) *The power unit.*—When a muscle has been injured, fibres are lacerated, blood and lymph are effused and the muscle is in spasm. True regenerative repair in a muscle is slight, and lacerated fibres are replaced by connective tissue. Effusion handicaps nutrition and—unless it is rapidly absorbed—pre-disposes the part to excessive fibrous tissue formation. Spasm tends to increase the damage to fibres. Tendon regenerates much better than muscle but is easily overstretched during the process, thus requiring increased tone in the muscle to take up the slack.

The treatment of sports injuries falls into two or three stages. During the first stage the principal requirement is rest—support or fixation—so that the origin and insertion are approximated. The area can be brought rapidly to the second stage by Mennell's gluco-kinesis—a form of sedative massage amounting to local hypnosis of the parts—and small doses of direct current.<sup>1</sup> If these special physical measures are not available, pain and spasm are relieved by glycerine and belladonna liniment applied on lint for 24–48 hours. Aspirin is helpful but should be given in powder form or the tablet should be sucked slowly.

The value of massage, passive movements, resisted movements and active re-educative movements in the later stages is known to all, but too little use is made of the Smart-Bristow (or “Bristow”) coil and the many interesting and valuable ways in which this apparatus can be used to re-condition injured and debilitated muscles. The apparatus is portable, reliable, simple and self-contained, works from dry cells and gives a

comfortable contraction. To get full value from it, treatment should be continued until the injured limb is at least equal to the uninjured one in circumference, and preferably until it is larger.

The achievement of good tone, condition and functional ability in the power unit is the keystone of the treatment of injuries of sport, and its importance cannot be exaggerated. Tone is the secret of sport. Formal exercises are often boring, but fencing, which can be carried out by artificial light after working hours, is an excellent exercise for the restoration of tone and will hold the patient's interest.

(3) *The lubricating system.*—Synovial membranes and bursæ are the anti-friction devices of the body; they are therefore naturally subject to minor injuries in all kinds of sport. There is no one specific treatment of synovitis, whether it be in a joint or in a tendon sheath. Each patient is a separate problem and his basic physical condition is the factor determining the choice between modified rest, support and movement. It is a good general rule never to give any but a guarded prognosis until the individual patient's response to treatment is manifest, as age, condition and inter-current ailments play so large a part in recovery.

The use of electrical currents and massage requires care and special technique if the condition is not to be made rapidly worse. There seems to be no doubt that variations in temperature are helpful. Some patients benefit from hot salt baths; others from cold evaporating lotions; others from an even temperature maintained by bandaging over cotton wool. The recently introduced "elastoplast"—a modified form of Unna's paste on an elastic bandage—is valuable in supporting parts where there is synovial effusion; it seems to provide a reasonable amount of support and rest without constriction and without preventing the small movements that are essential to recovery. It is less irritating than zinc adhesive strapping but does not give

the same firm support.

Traumatic bursitis is difficult to treat. Only one of the many methods I have tried has yielded a high percentage of successful results. This is a succession of erythema doses with the Kromayer lamp, every three to five days, to small areas of skin over the bursa. No other source of ultra-violet light gives such a good result. The treatment is almost specific for sub-deltoid bursitis provided there is no calcification.

(4) *The scavenger system.*—The lymphatic system acts as a whole, and toxic absorption in any part affects the drainage in any other part. The eradication of toxic foci is only important, however, in injuries of sport when the patient's capacity to deal with toxins is greatly lowered or the toxins are excessive in amount or virulence. The average healthy individual's reserve should be ample to deal with minor injuries and small toxic foci. Lymph flow is aided, directly or indirectly, by massage and many other physical methods. A simple and valuable technique is for the masseuse to wear a pair of rubber gloves and over these a pair of cotton gloves connected with a Bristow coil by means of a flexible electrode on the back of each hand. The gloves are soaked in warm soap solution and the hands can be used as electrodes while they carry out the movements of massage.

Spa treatment, with douches, massage, regular hours, ordered meals, rest and freedom from worry, is particularly valuable and should never be forgotten after any serious injury in sport. The importance of the auxiliary services of nutrition and nerve supply is obvious; on them everything ultimately depends, and they must never be forgotten by the practitioner.

#### Reference.

<sup>1</sup> Heald, C. B.: "Injuries and Sport," Oxford Medical Publications, 1931, p. 80.

## Chemotherapy in Cancer

BY W. BLAIR BELL, B.S., M.D., PRES.C.O.G., F.R.C.S.,  
HON. F.A.C.S.

*Professor of Obstetrics and Gynæcology in the University of Liverpool ;  
Obstetrical and Gynæcological Surgeon to the Liverpool Royal Infirmary ;  
President of the Medical Institution, Liverpool.*

THE term "Chemotherapy" is somewhat difficult to define. I have attempted to do so in the following words: "Chemotherapy denotes treatment by synthetic preparations which have a selective therapeutical action on abnormal tissues of the body and on the organisms that may infect it, with or without the production of associated constitutional phenomena."<sup>1</sup> Strictly speaking, therefore, biological methods of immunization are not included. It was, however, on the lines of such immunization that I worked twenty-five years ago<sup>2</sup>, and Lumsden<sup>4</sup> is now trying to solve the problem.

In these days we live in an atmosphere of preventive medicine, and although this has found its most dramatic performances in the prevention of bacterial and parasitic diseases, I for one never fail to urge that by prevention alone can we expect to reduce appreciably the terrible toll malignant disease is taking of human life. Yet this prevention may be chemotherapeutical in nature.

There is a considerable difference of opinion as to whether cancer should be considered a local disease, or regarded as a constitutional one. Obviously, from the point of view of the chemotherapeutist, this is of no real moment. It is, however, a matter of great importance to those who believe only in local forms

of treatment. The two chief types of local treatment are surgery and radiations—X-rays and radium emanations. Both of these methods have cured many cases of malignant disease, and it is, therefore, difficult to obtain a confession that local treatment is not a scientific method of attack, and that chemotherapy is.

Yet to those who practise local treatment only it must always be an anxious reflection that an apparent local "cure" by no means implies that the patient is safe from the perils of dissemination of the disease throughout the body, perhaps many years later. Moreover, I have seen cases of cancer of the cervix, apparently cured with radium, in whom there has subsequently been widespread dissemination in the peritoneal cavity and elsewhere. I have never seen this happen with untreated cancer of the cervix. So, too, an incomplete operation for malignant disease may lead directly to stimulation and spread of the growth.

After all, what are the triumphs of surgery and radium? Only those attaching to any form of destruction or removal of the well-known forms of the disease that for long remain localized. I could write a good deal about radium and the outlook regarding its value; but I am philosophically fascinated by the physical activities of this substance and have no wish to decry so beautiful a weapon, however imperfect. Besides, millions are being expended on radium, and money speaks.

Nevertheless, we must remember that of all the patients who die of malignant disease at least three-quarters of the number could never have been considered really suitable for local forms of treatment, by the time it was possible for anyone to discover the existence of the disease. So, I think, there is a case for chemotherapy, in spite of the fact that most investigators are at present absorbed in finding an extended

use for local methods.

The time will soon come when the pendulum will swing in the other direction. Yet surely even then we shall still combine local with chemotherapeutical measures in many cases. This is a practice of which I have never lost sight and employ whenever possible.

#### DIFFICULTIES OF CHEMOTHERAPEUSIS

When we have to deal with bacterial and parasitic diseases the problem of chemotherapeusis is not very difficult. We must seek for a selective poison for foreign organism that has obtained access to the host tissues, and also their functions, no doubt differ much from those wherein the organism has lodged. In malignant disease, on the other hand, the abnormal cells belong to the host and grow in a fundamentally similar manner to those of the normal tissues; and there are functional differences between the several types of neoplasm, according to their ontogenetic origin—differences which are similar to the functional variations of the many types of normal tissues from which the neoplasms have sprung.

It appears, then, that in our ideal chemotherapeutical material we may have a basal factor which arrests all growth—normal and abnormal—and some added factor which will interfere with the metabolism of the special cell-type; consequently, it may well be that in the end we shall have different preparations all containing, however, the essential anti-growth factor. Meanwhile special study has been directed by us to normal physiological malignancy as seen in the chorionic epithelium; and, in the absence of final knowledge concerning the nature of the inhibitory factor controlling the invasive properties of this tissue, and the isolation of it, we have turned to a poison, namely, lead, that appears to exert an almost specific destructive effect on the chorionic epithelium.

Another difficulty in the way of effective chemo-

therapeusis is the avascularity of many forms of cancer, and the fibrosis which may occur around the neoplastic cells, rendering them secure from the action of poisons circulating in the blood-stream.

In the final outcome of this form of treatment it appears likely that we shall come, indeed we are now coming, to the belief, that it is better slowly to damage—devitalize—the malignant cells and to leave them a prey to the eliminative activities of the predatory cells of the body. This seems better than attempting the rapid necrosis at which we originally aimed.

#### THE ACTION OF LEAD

The action of lead in inhibiting growth is well known. Many times we have described the effect of this metal on growing seeds and roots, and on animal development;<sup>2</sup> it has an almost unique effect of stunting—slowing growth—as well as arresting it entirely. This seems to depend on the dosage.

Again, we have shown how lead will cause coagulation necrosis in the chorionic epithelium of the rabbit without affecting the mother. This epithelium is particularly vulnerable not only because of its malignant and rapidly-growing propensities, but also because of its extreme vascularity. So, too, rapidly-growing cells which have reverted to malignancy appear to be plumbo-sensitive just as they are radio-sensitive; but it would seem that whereas radiations are physical, like heat, in their action, lead must act chemically. This action of lead has, however, never been satisfactorily demonstrated, in spite of all the chemical research conducted by ourselves and others. There are some who think the action of lead is constitutional; some who regard it as entirely local, and others, of whom I am one, who think it may act in both directions.

The different findings that have been recorded in regard to the lead content of treated neoplasms, must be correlated with the result of that treatment and the

accessibility—that is, the vascularity—of the growth. We do not disguise from ourselves the necessity of further controlled work on this question, for it can so readily be shown that in the case of stunting in vegetable growth lead is deposited both in the cell-walls and in and around the nuclei of the growing root-tips.<sup>2</sup> I cannot help believing that our original suggestion may prove to be not far wrong: namely, that the high phosphatide content of rapidly growing tissues is in some way affected by lead.

#### LEAD IN THE TREATMENT OF MALIGNANT DISEASE

Whether malignant disease be local or constitutional in origin—in my opinion it is local—there can be no doubt that profound constitutional disturbances soon become evident. No specific metabolic change to account for this has yet been conclusively demonstrated.

Many years ago Rosenheim and Shaw-Mackenzie<sup>5</sup> showed that the normal augmentative effect of serum on lipase activity is reduced in malignant disease, and also in other pathological states. As, however, the other conditions—for example, scarlet fever—can usually be readily recognized, it was thought that this co-enzymic reaction might be employed in the diagnosis of cancer. It is impossible to discuss this question at length here, but it may be mentioned that in cases under treatment with lead, and after effective operation, when the patient is doing well, the reaction returns to or towards the normal. We have, therefore, in this reaction a method of checking the effect of treatment.

Treatment with lead, especially with unsatisfactory preparations, may be very dangerous, and obviously the more so when employed by those unaccustomed to its use, and without proper laboratory facilities for making the necessary investigations of the hæmatological, hepatic and renal states. With experience we have reduced the danger practically to vanishing



point, and with it even discomfort to our patients. Still we have remained dissatisfied, for there is no doubt that in the early days those who suffered most, especially from small quantities of lead, often did best. It is clear, of course, that what we want is a material containing lead in a non-toxic form—that is to say, a colloid, a complex or a compound of lead from which the metal is but slowly dissociated, and, if possible, becomes fixed only in, or in the neighbourhood of, the growth, the excess being excreted unchanged. The chemotherapeutic index must be high.

Professor Lewis and Dr. Jowett have, I think, brought the preparation of colloidal lead itself to a high degree of perfection, and this product we still use; but we are not convinced that it is impossible to secure anything better. Professor Heilbron and Dr. Beilensohn are preparing for us many organic compounds which are being carefully tested pharmacologically and experimentally on animals with cancers, and about these I should like to say a few words.

In the first place, although we may succeed in curing animals with malignant disease by chemotherapeutical methods, it does not necessarily follow that the material which has been successful in them will be equally innocuous and useful in the case of the human subject; of this I will give an example directly. Yet, to-day, largely because certain scientific investigators see nothing of disease in man, they have laid down what in the final result amounts to the inflexible rule that what applies to animals applies to men. This is stretching the advantages of experimental pathology to breaking-point. To be provocative one may almost express the opinion that the chemotherapeutical product which will cure cancer in animals may be ineffectual in, or poisonous to, the human subject, but that which will cure cancer in man will almost certainly act in the same way with animals.

During the last fourteen months, owing to the

kindness of Professor W. P. Graves and Dr. Smith, of Boston, we have had in my laboratory the Brown-Pearce transplantable epitheliomatous neoplasm of the rabbit. This is a rapidly-metastasizing growth; every organ in the body being quickly involved. Untreated it is inevitably fatal, after the transplant has definitely taken. Approximately 80 per cent. "takes" can be secured. My colleague, Dr. Datnow, has now transplanted the growth about two hundred times. The best sites for transplantation are the ovaries and testes.

One animal with extensive metastatic tumours died in 22 days. The average duration of life without treatment is about 12 weeks.

An organic preparation,  $H_{126}$ -benzenesulphonyl-glycinate—prepared in Professor Heilbron's laboratory, gave most dramatic results when injected intravenously into animals with widespread metastases. An animal in which there were numerous metastases, and one in the left eye entirely recovered, although blind in the affected eye, and is alive now, 12 months later. Our successes in this direction are about 25 per cent. of animals treated. We hope soon to publish a paper on our experiences with this neoplasm.

Very effective as is this preparation ( $H_{126}$ ) in the case of the rabbit, we have found it impossible to use it on human patients owing to its great toxicity in them when injected intravenously. Rabbits are not very susceptible to lead. Moreover, it cannot be injected hypodermically or intramuscularly, for it is irritant. This has been a great disappointment to us.

However, a few weeks ago we had a visit from Dr. W. A. Collier of the Koch Institute, Berlin. We already knew of the successful work, based on our researches, which he had done in conjunction with Professor Krause in the treatment of mouse carcinoma with tri-normal-propyl-fluoride and other compounds

of lead, and published two years ago.

Dr. Collier assured us that there they have now become convinced, after extensive experimentation, that in lead we have the only known element that specifically affects cancer, apart, of course, from the local effects of radiations. He told us that they also were using the same material—namely, the Brown-Pearce rabbit-tumour—and had found it as satisfactory as we are finding it in respect of certainty of positive implantation and fatal outcome.

Dr. Collier then went on to say that his chemical colleague, Dr. Rothmann, had prepared a water-soluble, diffusible, organic compound in which the lead is not ionized, and which remains unaltered, as they had proved chemically, in the tissues when injected locally—a difficult thing to understand—and is slowly taken up in this state, without any toxic, but with a curative, effect on the malignant neoplasm of rabbits in 80 per cent. of all cases. Moreover, we were given to understand that the excess is excreted unchanged.\*

The German preparation is somewhat similar chemically to one prepared in Professor Heilbron's laboratory, which we rejected on pharmacological examination, and for which such claims as the above cannot be made. Evidently changes in the structural formula have brought about great differences in its properties.

Dr. Collier has only just commenced to treat human cases, but he informed us that no toxic symptoms have been seen, and that they are satisfied with the results.

I know well that Dr. Collier's work is incomplete and that nothing in the way of finality may come of it

---

\* Since this was written Dr. Collier has kindly sent us some of this preparation—a hygroscopic powder. So far as our examination of it has gone, we have confirmed all the statements made concerning its properties, except the facts that it is unaltered in the tissues, that it is excreted unchanged in the urine, and has high cancer-curative properties; but we have not completed our investigations in regard to these three important points.

in connection with human cancer. Still it is interesting to realize that in Germany, France, and the United States of America they think it worth while to persevere in a field of chemotherapy held by many in this country to be unworthy of more than crude clinical investigation. The same attitude, based, I am told, on the views obtaining here, was held at first at the Koch Institute, but I understand that this has been entirely changed by the results already obtained.

Fournier<sup>3</sup> at the French Congress of Medicine last year made the following statement :

He has for several years used injections of fumarate of lead in cases of cancer in which the tumour was inoperable or not accessible to X-ray or radium treatment. He has never observed injurious effects. On the other hand, he has had very encouraging results. All the patients have been relieved; many have been cured and their cure has been maintained for more than two years without recurrence.

I do not know whether these observations with lead fumarate have yet been confirmed by others or not.

In such a brief account as I have given of chemotherapy in cancer, it may be felt by some that I should have said more of the treatment of patients whom we have treated. In this respect I have at present little to add to what has already been published.<sup>2</sup> We have seen more than enough to realize that in many cases treatment with lead offers the only possibility of, and frequently secures, beneficial results. Moreover, we firmly believe that a course should always be given to patients after operations for malignant disease.

Finally, I must discuss the application of the word "cure" and the term "clinical cure" of malignant disease. With regard to the first, I suppose we can claim a cure of cancer provided every cancer cell throughout the body is destroyed; but how are we to be sure of this?

We have no test, and are unlikely ever to have any test which will indicate the presence of a few cancer-cells locked up in fibrous tissue somewhere in the body. These may remain quiescent throughout the life of the patient, in which case it would be claimed that he had been cured. On the other hand, the cells may become active twenty years later, and the patient die of the disease. As I have often said, the surgeon who talks of "five-years' cures" has an eye on his statistics only.

The term "clinical cure" is more cautious, for it only speaks of temporary observable conditions. Again we must not forget that while effecting a so-called "cure" a fatal non-malignant lesion may be produced. We have observed examples of cicatrical intestinal and ureteral obstruction in rabbits, and the too rapid destruction of growth in man has led to a fatal issue.

The treatment of the most inexorable disease that afflicts mankind is, indeed, a difficult task, with disappointments ever present. It requires in its pursuit courage and an optimistic determination not so much to secure dramatic results—these are thrown across the path of every pioneer to mislead him into the belief that he has reached his goal—as to confer the greatest good on the largest number.

### References.

- <sup>1</sup> Bell, W. Blair : *Lancet*, 1928, ii, 164.
- <sup>2</sup> *Idem.*, "Some Aspects of the Cancer Problem," 1930.
- <sup>3</sup> Fournier : *Presse méd.*, 1930, xxxviii, 1455.
- <sup>4</sup> Lumsden, T. : *Internat. Confer. Cancer Rep.*, 1928, 216.
- <sup>5</sup> Rosenheim, O., and Shaw-Mackenzie, J. A. : *Journ. Physiol.*, 1910, xl, *Proc.*, viii.

# The Relation of Dysentery Bacilli to Chronic Ulcerative Colitis

By J. ARNOLD BARGEN, M.D.

*Division of Medicine, The Mayo Clinic.*

MURRAY C. COPELAND, M.D.

*Fellow in Surgery, The Mayo Foundation.*

AND LOUIS A. BUIE, M.D.

*Section on Proctology, The Mayo Clinic, Rochester, Minnesota.*

VON ROKITANSKY, in 1848, was one of the first pathologists to give a differential description of bacillary dysentery, typhoid fever, and what is now known as chronic ulcerative colitis. The last he regarded as a catarrhal inflammation which occasionally passed into ulceration and suppuration, primarily excited by chemical irritation of the intestinal wall from stagnant fæces or as a consequence of venous congestion in the portal system. His description of the colon in suppurative catarrhal inflammation is analogous to the present conception of chronic ulcerative colitis. Wilks and Moxon, in 1875, and White,<sup>51</sup> in 1888, did much to support those who were contending that simple ulcerative colitis was distinct from true epidemic dysentery, although White stated that "the origin of this ulceration is extremely obscure." Up to the time of Allchin, in 1909, much difference of opinion existed as to the formative site of the ulcerations in simple ulcerative colitis. He was among the first to point out the submucosal origin of the disease rather than the follicular origin, feeling that the dysentery bacillus of Shiga was not the causative agent, citing the cases of Sidney Phillips which had yielded negative results in an attempt to isolate dysentery bacilli from them. He, however, left the matter *sub judice*. H. P. Hawkins, in 1909, de-

scribed the hæmorrhagic form of ulcerative colitis, suggested the possibility that the bacillus of dysentery was an etiologic factor, and pointed out that *Bacillus coli*, *Bacillus pyocyaneus* or the pyogenic cocci might act as secondary invaders in a lesion primarily formed by the dysentery bacilli.

Hale-White, in 1911, stated that he had met with cases of primary ulcerative colitis due to the *Bacillus coli*, pneumococci and streptococci, and felt that injections of autogenous vaccines had caused some improvement.

Bassler, in 1911 and 1913, pointed out that there was a definite group of colonic lesions due to *Bacillus coli communis*. Lockhart-Mummery, in 1913, reported a case in which he believed *Staphylococcus aureus* was the etiologic agent. Rosenheim, in 1908, proffered the idea of a change in colonic acidity and in the pathogenicity of the colon organisms as the cause of colitis. Lynch and McFarland, in 1916, regarded the normal flora as a prime factor in the etiology of the disease, and Logan, in 1919, considered a number of organisms potentially responsible for chronic ulcerative colitis if the bodily resistance was found to be lowered sufficiently.

In 1921 Hurst, and also Leusden, expressed the view that the condition was the result of a former infection by some form of dysentery bacillus, *Bacillus dysenteriae* disappearing from the stools, leaving the resulting lesions adumbrated by active secondary invaders. Having first observed marked benefit from intravenous administration of serum in cases of acute bacillary dysentery while visiting in Salonica, Hurst<sup>26, 27</sup> further substantiated his conception by giving patients suffering from chronic ulcerative colitis large doses of polyvalent antidysenteric serum, and reported good results. At that time, he believed that the serum had specific action on the disease.

In recent years many workers have suggested the

beneficial results which accrue from the use of plain serum, and it is interesting to note that Hurst<sup>28</sup> realized that treatment with polyvalent antidysenteric serum "may be non-specific and nothing more than a form of protein shock." He stated further, in 1927, that attempts at isolating the organism of bacillary dysentery either from the stools or from swabs taken directly from ulcers through a sigmoidoscope had failed to reveal the dysentery organism. However, from Hurst's<sup>29</sup> discussion of the disease in 1931, one gets the impression that he believes anti-dysentery serum to have specific properties. He quoted the finding of *Bacillus dysenteriae* in nine cases of what was thought to be colitis, in the practice of seven physicians (Nabarro, 1912; Dudgeon, 1923; Hadfield, 1927; Thoralakson and Cadman, 1928; and Knott and Hurst, 1930) over a period of eighteen years as evidence favouring the etiologic relationship of the organism to chronic ulcerative colitis. Could not these sporadic observations be evidence of incidental invasion? Dukes dismissed the theory that the disease is due to *Bacillus dysenteriae* because of "almost universally negative bacteriological and epidemiological evidence, the absence of agglutination and the uncertain effect of antidysentery serum." Tidy has had no success with the use of anti-dysentery serum in the treatment of chronic ulcerative colitis. Sir Charles Gordon-Watson stated that he had tried anti-dysentery serum in a large number of cases but had never satisfied himself that there had been much benefit from it. He had a dramatic result in one case, but relapse occurred a year or two later, and the patient did not respond to anti-dysentery serum the second time. Crohn, in 1927, expressed the opinion that the serum acts entirely as any foreign protein would; he has been unable to isolate organisms of dysentery or to get convincing agglutinations in blood serum of known dysentery bacilli in cases of "non-specific ulcerative colitis."



Thorlakson, in 1924, advanced the view of those who held that chronic ulcerative colitis was due to the bacillus of dysentery, and in 1928 he<sup>48</sup> presented cultural evidence in favour of such a view. A specimen was taken from the base of an ulcer in five cases. He used a sharp-cutting curette, thus obtaining more material than simply a smear from the surface. He felt that this was the reason that Cadman had been able to isolate organisms of dysentery in four of the five cases investigated. A serum was prepared and used, he said, with gratifying results.

Garrod has examined the patients admitted to St. Bartholomew's Hospital for the last two or three years and has made cultures from swabbings of the ulcers taken by sigmoidoscopy and has not found dysentery bacilli in any case. In eleven of seventeen cases in which examination was made for the diplo-streptococcus described by one of us, it was found, and Garrod regarded this organism of considerable significance.

One of us (Bargen),<sup>2</sup> in 1924, began a study on the etiology of chronic ulcerative colitis and, at the outset, attempted to isolate organisms resembling the dysentery bacillus, but without success. However, large numbers of Gram-positive diplococci were found in cultures taken from the bases of the ulcers with sterile swabs that were passed through a proctoscope after the bowel had been adequately prepared. It was suggested that this diplo-streptococcus, of definite morphological, cultural and biological characteristics, played an important part in the causation of certain cases of chronic ulcerative colitis. Later studies<sup>6</sup> have done much to confirm this and to establish the organism as the important etiologic factor of this definite entity.<sup>18, 24, 44</sup>

#### CLINICAL PHENOMENA

It is well, before going into the investigative work, to survey the outstanding features of the disease.

They comprise usually a gradual onset with diarrhœa, rectal discharges of blood, pus and mucus, mixed with fæces of varying consistence, usually a mild, sometimes a severe, febrile course, and the passage of from ten to fifty stools and rectal discharges a day. The disease usually begins in the rectum or sigmoid, and, extending upward, may invade any sector of the colon, or often the entire large bowel.

The proctoscopic examination is of prime importance in the diagnosis of chronic ulcerative colitis. Buie and others have described the typical proctoscopic picture. The appearance of the mucosa of the rectum and sigmoid in the four phases of activity in the disease, namely, hyperæmia, œdema, miliary abscesses, and miliary ulcers, is not easily confused with that of any other known lesions of these structures. The stage of remission, too, carries its typical proctoscopic picture.

The roentgenoscopic and roentgenographic features of this disease are characteristic and often most helpful in determining the extent of the lesion and the degree of activity and involvement of the wall of the bowel. Occasionally, late in the disease, the lower part of the ileum is found to be involved.

After repeated exacerbations of the disease, the colon gradually becomes denuded of much, or most, of the mucosa, so that, at necropsy, it presents islets of mucosa, on which there are typical signs of the disease, on a dense base of granulation tissue, the wall of the bowel being very thick and non-elastic.

#### EXPERIMENTAL STUDY

Following the lead of Thorlakson,<sup>48</sup> in 1928, we selected consecutive cases of chronic ulcerative colitis, taking both the mild and acute cases for study. Data concerning these patients are given near the end of this paper. If not too ill, the patients were first prepared by washing out the lower part of the bowel

thoroughly until the mucous membrane was relatively clean of all extraneous material. If the patient appeared to be too ill, the study was made at a later date, when the bowel could be properly prepared.

Material for culture was obtained through the proctoscope by means of a curette, and a portion of the base of the ulcer was removed for study from forty-eight consecutive patients. This specimen of tissue was transferred to a sterile test-tube containing 1 c.cm. of physiological solution of sodium chloride and was kept at 37·5° C. for about six hours. The tissue was then macerated in a sterile mortar, with 1 c.cm. of sterile physiological solution of sodium chloride. The technic of Davison was utilized to some extent in culturing the macerated material. A loop full of the material was streaked over a Petri plate of Endo's medium, and then, without flaming the loop, it was streaked over another plate of Teague's medium.<sup>41, 45, 46</sup> A second loop of material was streaked over a plate of von Drigalski and Conradi's medium.<sup>17</sup> After eighteen hours of incubation at 37·5° C., the plates were carefully checked for colourless typhoid-like colonies, but in only three cases were they seen.

The suspicious colony from the first case was placed in lactose peptone, but did not cause fermentation. The organisms in a culture that was twenty-four hours old were motile, Gram-negative, and gave a green fluorescent appearance to the broth. Further investigation proved the organism to be *Bacillus pyocyaneus*.

The organisms in the suspicious colonies from the other two cases, after further investigation, proved to be motile, were Gram-negative, and fermented sugars in the manner characteristic of Morgan's bacillus number 1.<sup>32, 36</sup> In no case was there any evidence of the presence of an organism which did not ferment lactose, a characteristic of the organism of dysentery.

Specimens were also removed in eight other cases and the material diluted at the proctoscopic table in

warm normal solution of sodium chloride and then immediately streaked on plates of Endo's, Teague's, and von Drigalski and Conradi's medium. In this way, less than five minutes elapsed from the time the material was scooped from the wall of the bowel until it was satisfactorily transferred to the incubator, on the various mediums. No organisms which did not ferment lactose grew on any of these.

A parallel group of curetted specimens was prepared in the same manner as that described and cultured according to the technique of Barga<sup>3</sup> after Rosenow. The diplo-streptococcus of chronic ulcerative colitis was isolated in forty-five of the forty-six cases under investigation, or in about 80.4 per cent. of the cases. Only a single attempt was made to culture in each case.

It is often stated that the serological reactions in dysentery are uncertain<sup>16, 42, 43, 53</sup> although many authors claim that they are of the greatest value,<sup>12, 30, 38</sup> and that the serum of normal persons does not agglutinate the organisms of dysentery.<sup>13</sup> Davison stated that the confusion in regard to reliability of the diagnosis of bacillary dysentery by agglutination is largely due to two factors: first, the multiplicity of types of the Flexner bacillus makes likely the omission of one or more of them in agglutination tests, and the serum of some patients which might agglutinate one or more of the omitted types, may be reported as negative; second, living cultures are frequently employed as antigens. Living cultures vary from time to time in their agglutinability; therefore, agglutination tests made with cultures of organisms of dysentery, killed by formol, are much more reliable.

In cases of long-standing infection with organisms of dysentery, it is difficult to ascertain from the literature the length of time agglutinins may persist in the patient's blood. Davison reported four cases in children, in which agglutinins were found to be present after six months. With such meagre information at

hand it is evident that further studies should be made in regard to the condition of the patient's blood at long intervals after the infection is known to have occurred.

With the facts that have been given in mind, twenty cases were selected from among those in which cultures had been made from rectal lesions, as reported in the foregoing study. Five cubic centimetres of blood were withdrawn from each patient, and were allowed to clot under sterile conditions. The blood was then centrifuged, and macroscopic dilutions were set up ranging from 1 to 5 up to 1 to 320. Then 0.5 c.cm. of a killed and tested standard agglutinable culture of Flexner bacillus, bacillus Shiga, bacillus Hiss-Russell, bacillus Strong (organisms of the national type culture collection), and the diplo-streptococcus of chronic ulcerative colitis were added, each to a series of dilutions of serum. These tubes were incubated at 37.5°C. for twenty-four hours; the results are given at the close of the paper. It is interesting to note that no patient's serum agglutinated the organisms of the dysentery group in dilutions of more than 1 to 20. Authorities on the subject feel that agglutinins must be present sufficiently strong in dilutions of 1 to 30 or weaker to be diagnostic of dysentery, if we can assume that cases of long standing retain the usual amount of agglutinins in their blood.

In several cases the diplo-streptococcus of chronic ulcerative colitis was agglutinated in dilutions of from 1 to 40 up to 1 to 320. Although this part of the work is interesting in passing, we feel that further studies, with a larger series of cases, under properly controlled conditions, will be necessary before any statement can be made concerning agglutination of this diplo-streptococcus. It has long been known that the agglutinins in the patient's blood are very low for prolonged infections caused by the various cocci, and therefore agglutination has been little used for

diagnostic purposes.

The ages of the patients ranged from fifteen to fifty years, inclusive; seven were in the second decade of life; twenty in the third, nineteen in the fourth, and ten in the fifth. Thirty were males; twenty-six were females.

The duration of symptoms, which were of the type caused by an inflammatory ulcerative disease of the intestine, varied from one month to twenty years. A fair number of patients had had symptoms for only one month to several months. These patients were acutely ill, and presented fever, general malaise, exhaustion, anæmia, and frequent bloody, purulent, rectal discharges. Those who had been afflicted for a longer time, usually had had many acute exacerbations, and finally, continuous trouble. All had had symptoms named, in variable degree, to which might be added one or all of the following additional complaints: pain, cramps, urgency, gaseous dyspepsia, flatulence, nausea, tenesmus, and discharge of varying amounts of mucus.

The sigmoidoscope in all cases revealed the usual granular, easily-bleeding oedematous mucous membrane. The wall was studded in some cases with miliary abscesses; in others, the disseminated, shaggy, larger ulcers of the secondary type were present.

The extent of involvement of the colon varied. It was determined by roentgenographic and roentgenoscopic examinations after barium enema. In all cases the rectum and sigmoid was extensively diseased; in twenty-four, the entire large intestine was involved in the ulcerative process; in nine, disease of the colon above the sigmoid was not demonstrable by roentgenologic methods. In the others the extent of the disease varied; in some involvement extended proximally as far as to the splenic flexure, in some to varying portions of the transverse colon, and in some to the hepatic flexure. The typical roentgenological picture produced

by this disease has been graphically described elsewhere.<sup>4 5. 7. 50</sup>

The degree of anæmia varied, but all patients were anæmic. The lowest concentration of hæmoglobin, estimated by the Dare method, was 25 per cent. Increase in the leucocyte count was common, but it was not high; in any case the maximal number of leucocytes in a cubic millimetre of blood was 18,000.

Repeated search for parasites in the stools and rectal discharges of forty-seven of these patients gave negative results. In the rectal discharges of one of the remaining nine patients, *Entamæba histolytica* were found. Eight harboured organisms that apparently were of little, if any, significance from the standpoint of pathogenicity; these included *Entamæba coli*, *Endolimax nana*, *Chilomastix mesnili*, and *Trichomonas hominis*.

The diplo-streptococcus of chronic ulcerative colitis was isolated from cultures made from material obtained by curettage of the intestinal walls of forty-five of the patients; from two a Morgan bacillus number 1 was isolated, and from one *Bacillus pyocyaneus*; no other organisms that did not ferment lactose were isolated. Dysentery bacilli of any kind did not grow in any of the cultures.

Agglutination tests, in which the serum of twenty of the patients and specific organisms were used, gave the following results. There was no agglutination of the Shiga bacillus by any of the twenty serums. There was agglutination of the Flexner bacillus by only two of the serums, one in dilutions of 1 to 10, and the other in dilutions of 1 to 20. There was no agglutination of the Hiss-Russell bacillus by any of the twenty serums. There were the following agglutinations of the Strong bacillus, respectively, by the serums of five patients: in dilutions of 1 to 5, 1 to 10, 1 to 10, 1 to 20, and 1 to 20. Two of these serums were the same as those in which agglutination of the Flexner bacillus took place. The reasons why such agglutinations are not significant

have been given earlier in the paper.

#### SUMMARY

Fifty-six cases of chronic ulcerative colitis have been studied consecutively. The bases of ulcers in properly prepared colons have been curetted and cultures for bacillary dysentery and the diplo-streptococcus of chronic ulcerative colitis have been made from the curettings. We were unable in any case to isolate any organism simulating organisms of dysentery. In only three cases did we find organisms which failed to ferment lactose, and these proved to be *Bacillus pyocyaneus* in one case and Morgan's *Bacillus* No. 1 in two cases. The diplo-streptococcus of chronic ulcerative colitis was isolated in forty-five of the fifty-six cases under investigation, or in about 80·4 per cent. of the cases. The agglutination tests did not suggest that any of the patients studied were ever infected with bacillary dysentery.

#### Bibliography.

<sup>1</sup> Allchin, W. H. : Ulcerative colitis. *Proc. Roy. Soc. Med.*, 1909, II (Med. Sec.), 59-79.

<sup>2</sup> Bargen, J. A. : Experimental studies on the etiology of chronic ulcerative colitis. *Journ. Am. Med. Assn.*, 1924, lxxxiii, 332-336.

<sup>3</sup> *Idem.* : The etiology of chronic ulcerative colitis. *Arch. Int. Med.*, 1925, lxxvi, 818-829.

<sup>4</sup> *Idem.* : The treatment of chronic ulcerative colitis as based on the demonstration of a definite causative micro-organism. *Journ. Iowa State Med. Soc.*, 1926, xvi, 218-221.

<sup>5</sup> *Idem.* : The etiology and treatment of chronic ulcerative colitis. *Am. Journ. Roentgenol. and Radium Therap.*, 1926, xvi, 10-16.

<sup>6</sup> *Idem.* : The treatment of chronic ulcerative colitis. *Minnesota Med.*, 1927 (Nov.), x, 689-694. The medical management of chronic ulcerative colitis. *Tr. Am. Gastro-Enterol. Assn.*, 1927, xxx, 145-159. Changing conceptions of chronic ulcerative colitis. *Journ. Am. Med. Assn.*, 1928 (Oct. 20), xci, 1176-1181.

<sup>7</sup> *Idem.* : Chronic ulcerative colitis : a review of investigations on etiology. *Arch. Int. Med.*, 1930 (April), xlv, 559-572.

<sup>8</sup> Bassler, Anthony : Observations in four cases of chronic dysentery, non-amœbic in nature. *Med. Rec.*, 1911 (Oct. 7), lxxx, 714-715.

<sup>9</sup> *Idem.* : Ulcerative colitis. *Interstate Med. Journ.*, 1913 (July), xx, 707-716.

<sup>10</sup> Buie, L. A. : Chronic ulcerative colitis. *Journ. Am. Med. Assn.*, 1926 (Oct. 16), lxxvii, 1271-1274. Differential diagnosis of amœbic



dysentery and chronic ulcerative colitis by proctoscopic examination. *Surg., Gynec., and Obst.*, 1928 (Feb.), xlii, 213-215.

<sup>11</sup> Crohn, B. B.: Non-specific ulcerative colitis. *Tr. Sec. Gastro-Enterol., Am. Med. Assn.*, 1927, 136-147.

<sup>12</sup> Davison, W. C.: Bacillary dysentery in children. *Johns Hopkins Hosp. Bull.*, 1920 (July), xxxi, 225-234. Bacteriological and clinical consideration of bacillary dysentery in adults and children. *Medicine*, 1922 (Nov.), i, 389-510.

<sup>13</sup> Dukes, Cuthbert: Discussion. *Proc. Roy. Soc. Med.*, Sect. Surg., 1931, 793-795.

<sup>14</sup> Duhot, E., and Damade, R.: Sur les sensibilisatrices anti-dysentériques. *Journ. de méd. de Bordeaux*, 1919, lxxix, 265-268.

<sup>15</sup> Endo, S.: Ueber ein Verfahren zum Nachweis der Typhusbacillen. *Centralbl. f. Bakteriolog.*, 1904, xxxv, 109-110.

<sup>16</sup> Flu, P. C.: Over het voorkomen van agglutinen tegenover flexnerbacillen in het bloedserum van normale personen in Batavia. *Mededeel. v. d. burgerl. geneesk., Dienst. in Nederl. Indie.* Batavia, 1918, vi, 111.

<sup>17</sup> Ford, W. W.: Textbook of bacteriology. Philadelphia, W. B. Saunders Co., 1927, p. 132.

<sup>18</sup> Fradkin, W. Z. and Gray, Irving: Chronic ulcerative colitis. Report of vaccine therapy. *Journ. Am. Med. Assn.*, 1930, xciv, 849-852.

<sup>19</sup> Garrod, L. P.: Discussion. *Proc. Roy. Soc. Med.*, Sect. Surg., 1931, p. 800.

<sup>20</sup> Gordon-Watson, Charles: Discussion. *Proc. Roy. Soc. Med.*, Sect. Surg., 1931, 800-801.

<sup>21</sup> Hawkins, H. P.: An address on the natural history of ulcerative colitis and its bearing on treatment. *Brit. Med. Journ.*, 1909 (March 27), i, 765-770.

<sup>22</sup> Hawkins, H. P., and Butler, G. G.: Statistics of ulcerative colitis from St. Thomas's Hospital. *Proc. Roy. Soc. Med.*, Med. Sec., 1909, ii, 128-138.

<sup>23</sup> Hippocrates: "The Genuine Works of Hippocrates." New York, W. Wood & Co., 1886, i, 388 pp.; 1886, ii, 346 pp.

<sup>24</sup> Horgan, Edmund, and Horgan, Joseph: Chronic ulcerative colitis: Results of treatment with vaccine in five cases. *Journ. Am. Med. Assn.*, 1929 (July 27), xciii, 263-266.

<sup>25</sup> Hurst, A. F.: Ulcerative colitis. *Guy's Hosp. Rep.*, 1921 (Jan.), lxxi, 26-41.

<sup>26</sup> *Idem.*: Discussion on colitis. *Proc. Roy. Soc. Med.*, Sect. Surg., 1923, xvi, 106-108.

<sup>27</sup> *Idem.*: Ulcerative colitis. In: "Medical essays and addresses." New York, P. B. Hoeber Inc., 1925, pp. 150-168.

<sup>28</sup> *Idem.*: Discussion on the diagnosis and treatment of colitis. *Proc. Roy. Soc. Med.*, Med. Sec., 1927, xx, 1-14.

<sup>29</sup> *Idem.*: A paper on ulcerative colitis. *Brit. Med. Journ.*, 1931 (April 25), i, 693-694. Discussion on ulcerative colitis. *Proc. Roy. Soc. Med.*, Sec. Surg., 1931, 785-793.

<sup>30</sup> Kisskalt, Karl: Das jahreszeitliche Auftreten der Kriegsseuchen. *Deutsch. med. Wchnschr.*, 1915 (May), i, 579-582.

<sup>31</sup> Leusden, J. T.: (Observations on colitis ulcerosa with a contribution to the knowledge of the pathogenic effects of colon bacilli.) *Nederl. Tijdschr. v. Geneesk.*, 1921, lxxv, 2890-2905.

- <sup>32</sup> Levine, Max, Ajwani, G. A., and Weldin, J. C. : The Morgan group of paratyphoids. *Am. Journ. Pub. Health*, 1925, xv, 17-21.
- <sup>33</sup> Lockhart-Mummery, P. : Case of ulcerative colitis, terminating fatally. *Proc. Roy. Soc. Med., Clin. Sec.*, 1913, vi, 209-212.
- <sup>34</sup> Logan, A. H. : Chronic ulcerative colitis : a review of 117 cases. *Northwest Med.*, 1919 (Jan.), xviii, 1-9.
- <sup>35</sup> Lynch, J. M., and McFarland, W. L. : Colonic infections. *Journ. Am. Med. Assn.*, 1916 (Sept. 23), lxxii, 943-948.
- <sup>36</sup> Morgan, H. de R. : Upon the bacteriology of the summer diarrhoea of infants. *Brit. Med. Journ.*, 1906 (April 21), i, 908-912; 1907 (July 6), ii, 16-19.
- <sup>37</sup> Phillips, S. : A case of fatal acute ulcerative colitis with some unusual symptoms. *Proc. Roy. Soc. Med., Med. Sec.*, 1908, i, 161-168.
- <sup>38</sup> Rajchman, L., and Western, C. T. : Report upon 878 cases of bacillary enteritis. *Med. Res. Council, Special Rept.*, No. 5, 1917, pp. 7-97.
- <sup>39</sup> von Rokitsansky, Carl : Inflammations of the intestinal mucous membrane. In : "A manual of pathological anatomy." London : Sydenham Society, 1848, pp. 63-88.
- <sup>40</sup> Rosenheim, T. : Ueber colitis chronica gravis. *Deutsch. med. Wchnschr.*, 1908 (Feb.), i, 265-269.
- <sup>41</sup> Schöbl, O. : Experience with methylene blue-eosin lactose agar in searching for bacillus dysenteriae in stools. *Philippine Journ. Sc.*, 1919, xiv, 235-237.
- <sup>42</sup> Shiga, K. : Bacillary dysentery. "Modern Medicine." (Osler, and Mc Crae,) 1913, pp. 766-782.
- <sup>43</sup> Stokes, A., and Bigger, J. W. : Dysentery in Dublin in 1919. *Dublin Journ. Med. Sc.*, 1920, s. 4, 3-8.
- <sup>44</sup> Streicher, M. H., and Kaplan, Bertha : Chronic ulcerative colitis. *Journ. Am. Med. Assn.*, 1930 (Jan. 4), xciv, 10-12.
- <sup>45</sup> Teague, Oscar, and Clurman, A. W. : A fluid enrichment medium for the isolation of typhoid bacilli from stools. *Journ. Med. Res.*, 1916 (Sept.), xxxv, 107-130.
- <sup>46</sup> Teague, O. and Travis, W. C. : A new differential culture medium for the cholera vibrio. *Journ. Infect. Dis.*, 1916, xviii, 601-605.
- <sup>47</sup> Thorlakson, P. H. T. : *Can. Med. Assn. Journ.*, 1924, xiv, 1168-1173.
- <sup>48</sup> *Idem* : *Can. Med. Assn. Journ.*, 1928, xix, 656-659.
- <sup>49</sup> Tidy, H. L. *Proc. Roy. Soc. Med.*, 1931 (Sect. Surg), 797-798.
- <sup>50</sup> Weber, H. M. : *Med. Clin. N. Amer.*, 1930 (May), xiii, 1461-1472.
- <sup>51</sup> White, W. Hale : On simple ulcerative colitis and other rare intestinal ulcers. *Guy's Hosp. Rep.*, 1888, xlv, 131-162.
- <sup>52</sup> *Idem*. : The principles of the treatment of colitis. *Clin. Journ.*, London, 1911, xxxviii, 49-53.
- <sup>53</sup> Whitmore, E. R. : Bacillary dysentery. In : "Nelson Loose Leaf Medicine," New York, 1920, pp. 160-176.
- <sup>54</sup> Wilks, Samuel, and Moxon, Walter : "Lectures on pathological anatomy." Ed. 2. London : J. and A. Churchill, 1875, p. 672.

# Tuberculosis of the Larynx

BY SIR JAMES DUNDAS-GRANT, K.B.E., M.D., F.R.C.S.

*Laryngologist to the Brompton Hospital for Consumption and to the Cancer (Free) Hospital; Consulting Surgeon to the Central London Ear, Nose and Throat Hospital, and the West End Hospital for Nervous Diseases.*

**T**UBERCULOSIS when affecting the larynx is a cause of so much local pain and so much aggravation of the patient's suffering that its special consideration is not merely justified but definitely called for.

I shall endeavour to indicate some points in the diagnosis and treatment of this condition, especially those which are most applicable in general practice. In many diseases the results of treatment are favourable in proportion to the early stage at which the correct diagnosis is arrived at and of none, perhaps, is this more true than of tuberculosis of the larynx, when considered in itself, apart for the moment, from the all-important question of the pulmonary and general condition. That local treatment in its widest sense carried out in good time can often bring about local recovery or afford enormous relief is probably accepted by all.

The specialist is not infrequently called upon to decide whether hoarseness in an otherwise apparently healthy person is or is not due to laryngeal tuberculosis; but, as it comes before the general practitioner, it is generally in a person suffering from pulmonary tuberculosis, and it suggests its presence by the occurrence of persistent and increasing hoarseness or pain in swallowing. In the more advanced stages there may be regurgitation of liquid into the larynx with the most violent cough during drinking.

Under these circumstances the practitioner is not likely to be at a loss as to the diagnosis. There are, however, cases in which the disease may have developed in the larynx while the signs of tuberculosis of the lung may still be so slight as to escape detection. In these the laryngoscope has to be brought into requisition, though much can be done without it in the way of diagnosis and treatment.

The various non-pathognomonic and other local symptoms may advantageously be considered from the practical point of view as ranging themselves in two categories, those of intrinsic and those of extrinsic disease. In intrinsic tuberculosis the symptoms are chiefly disturbance of voice, cough, and occasionally obstructed respiration. On the other hand, the outstanding feature in the extrinsic forms is pain, most marked during swallowing.

The occurrence and persistence of these symptoms in patients suffering from undoubted pulmonary tuberculosis should leave the practitioner in little doubt as to the condition with which he has to deal. When they occur, and persist, apart from manifestations of pulmonary disease, the difficulties which arise may be considerable, though seldom insurmountable. They may then have to be met by means of laryngoscopy, but it is not proposed to describe here the pathological and laryngoscopical appearances of tuberculous lesions in the larynx.

If laryngoscopical examination is for any reason impracticable, any uncertainty may often be cleared up by *the detection of tubercle bacilli* if present, but their presence may be overlooked on account of the unsatisfactory character of the specimen of sputum supplied by the patient. By means of the following methods I have frequently been able to obtain positive results when previous examinations had been negative.

Many patients seem to be unable to eject the liquid from the bronchi, but involuntarily swallow it and

spit out little more than frothy saliva from the mouth. By means of *coaxing*, and urging them to "shoot it out into the bowl" while the head is kept down over it, with the mouth wide open, a better specimen may often be obtained. If this fails, an active cough reflex may be excited by getting the patient to sniff the *vapour of oleum sinapis volatile* from the neck of a bottle (say a six-ounce medicine bottle) at the bottom of which there is about half an ounce of the oil. This gives off the vapour all the more readily if the bottle is warmed over a lamp. Two or three sniffs generally result in a good cough and the expulsion (with a little encouragement) of the ejecta from the larynx and trachea into the basin.

Another method of value when by any chance the former fails is the *intralaryngeal injection*, by means of a syringe, of a few drops of a weak solution of sodium bicarbonate to which is added a little hydrogen peroxide. This is done under the guidance of the laryngeal mirror, and it often works well, but in some cases we are baulked by the obstinate closure of an irritable larynx. In a case of this kind the patient either could not, or would not, cough, and failed to respond to the methods above described. I, therefore, applied to his case the principle of *transnasal instillation* (see p. 258) used for the introduction of oily solutions into the larynx. The patient was seated with his head thrown back and his mouth wide open. He was instructed to "pant in and out" through his mouth and not to swallow. While he was doing this I gently syringed about half a drachm of the soda and peroxide solution drop by drop through the nose. A small quantity entered into the larynx and started a cough which resulted in the expulsion of a little sputum into the basin. Tubercle bacilli were found, and the diagnosis established.

I have occasionally caught on the *laryngeal mirror* a little patch of sputum sufficient for staining purposes,

if the patient coughed spontaneously, or did so by instruction during the examination. The examiner does well to wear a muslin veil when practising this last method.

The administration of *potassium iodide* for a few days, if not otherwise contraindicated, facilitates the expulsion of sputum.

Early *general wasting of muscles* is characteristic, and a suggestion for diagnosis is afforded by palpation of the supraspinous fossæ of the scapulæ, or the lower end of the quadriceps extensor cruris above the patella. The diagnosis often lies between tuberculosis and cancer, and, in the presence of laryngeal symptoms, early wasting and cachexia are, on the whole, more characteristic of tuberculosis.

There are many *other causes of persistent hoarseness*, and among them is epithelioma of the vocal cord, the early detection of which is of vital importance, as its successful eradication by operation can be almost guaranteed if it is dealt with at an early stage, and remarkable results have been obtained from treatment by radium. It need, therefore, hardly be said that delay in submitting the subject of persistent increasing hoarseness to laryngoscopic examination is most dangerous. Simple growths on the vocal cords and paresis or paralysis of the internal muscles may also produce disturbance of voice.

Another most important cause of hoarseness and cough is a form of laryngitis produced by the *inhalation of septic or irritating fluids from the nose* by way of the naso-pharynx. The laryngoscope then often reveals small greenish crusts of inspissated muco-pus on the vocal cords and walls of the larynx. The condition in question sometimes gives rise to suspicion of tuberculosis, and has been called "*pseudo-phthisis.*" The presence of muco-purulent discharge in the nasal fossæ or accessory sinuses puts us on the right track, and the great improvement effected by irrigation of

the nose, even if practised only experimentally, for two or three weeks, may confirm the fact that the nasal trouble is the cause of the symptoms. Such experimental irrigation may be carried out by means of various douches, but the simplest and safest is one in which the only force employed is snuffing inspiration, so that the Eustachian tubes are only jeopardized to a minimal degree, if at all. I mention this here on account of its value in diagnosis, but I shall revert to it in my suggestions for treatment.

*Cough* is another important symptom and, though usually excited by the presence of discharges in the bronchial tubes in considerable quantity, it may be due to irritation of the larynx or the pharynx. Certain regions seem to merit the title of "cough-spots," and among these the interarytenoid space and the sub-glottic region seem the most sensitive. The mucous membrane of the bifurcation of the trachea is credited with sharing this sensitiveness. It is probable that the coughing reflex is excited when the discharges come in contact with these spots. In the pharynx the "lateral" bands, behind the posterior faucial pillars, and the lingual tonsil are possible cough-spots. An elongated uvula may add to the patient's discomfort.

In order to decide whether a cough is due to irritability of the lateral bands we test whether it is allayed by anæsthetization of these parts. For this purpose I gently paint them with a 50 per cent. solution of guaiacol in glycerine. If relief follows, it may be made more permanent by the application of deliquescent trichloracetic acid, the result being frequently quite striking.

*Pain in swallowing* occurring in the course of pulmonary tuberculosis usually indicates infiltration and ulceration of the outer surfaces of the epiglottis, or ary-epiglottic folds, "extrinsic" ulceration. It usually develops somewhat gradually and adds greatly to the patient's suffering and debility, thereby

hastening the end. The means we have at our disposal for relieving the pain and thereby restoring the ability to swallow are, therefore, well worthy of careful consideration.

It should be kept in mind that the sudden onset or exacerbation of pain in swallowing in a case of tuberculosis, though often a very disturbing and painful occurrence which may sometimes mean a final outbreak of miliary tubercle and the beginning of the end, is occasionally the result of an ordinary acute lacunar tonsillitis to which the subject of laryngeal tuberculosis is as liable as anyone else. The fact that the tonsil is the site of the cause of the pain may often be confirmed by the subsidence of the pain on the application of an analgesic paint, such as the 50 per cent. solution of guaiacol in olive oil or, preferably, glycerine.

One of the most serious symptoms in advanced laryngeal tuberculosis is the *regurgitation of fluids* into the larynx and trachea during drinking. It is usually due to loss of substance in the interior of the larynx and such a degree of infiltration and rigidity of the framework as to interfere with its closing sufficiently to keep out ingested liquids. There then ensues a cough of such severity that the patient's condition is most pitiable. As a rule this symptom heralds in a "swallowing-pneumonia" and fatal termination.

In doubtful cases as, for instance, where the diagnosis lies between cancer and tubercle and the resemblance between the two as occurring in the larynx may be very close, the situation may be cleared up by the *microscopical examination of a portion of diseased tissue* removed by means of forceps. This is often a very difficult and delicate procedure, but not infrequently there is sufficient proliferated tissue projecting from the side-wall for removal by even a comparative novice in laryngoscopy, more especially if he employs such forceps as my "safety" endolaryngeal one. The drawing is self-explanatory, and it may be



that although not strictly "fool-proof" it is, at least, comparatively safe. It is important that the angle between the points and the shank should not be a right angle but larger, approximately  $110^\circ$ , so as not to

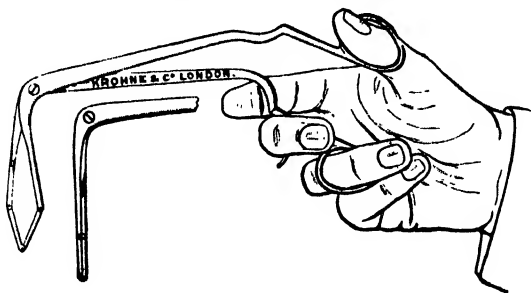


FIG. 1.—The author's safety endolaryngeal forceps.

impinge on the anterior wall of the trachea which runs downwards and backwards.

In illustration, the section (Fig. 2) is from a portion



FIG. 2.—Typical epithelioma. (Previous diagnosis, tuberculosis.)

of tissue removed for microscopical examination in a case sent from a reliable laryngological clinic as one of tuberculosis. The resemblance was extremely marked, but the microscope showed that the disease was really epithelioma. Similarly the section (Fig. 3), which is

manifestly tuberculosis, is from a patient who was sent to the Cancer Hospital as a case of epithelioma of

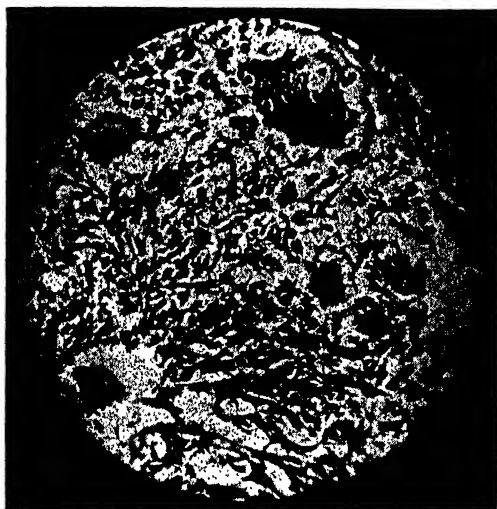


FIG 3.—Tuberculous tissue with typical giant-cells.  
(Previous diagnosis, epithelioma.)

the larynx.

#### TREATMENT

By far the most frequent symptom of laryngeal tuberculosis is *hoarseness or loss of voice*, due to infiltration or ulceration of the vocal cords. For this condition much may be accomplished by means of local applications, but a much more valuable remedy, and one more easily available, is rest of the parts by the maintenance of *complete silence*. This is easy to order, but it necessarily puts a great strain on the determination and cheerfulness of the patient. A very distinguished *confrère* kept silence for six months and made a complete recovery. A lady under my care did the same so conscientiously that when the condition of the larynx justified her being permitted to speak she had so completely lost the faculty that it was some time before she could find her voice. She also has been well and hearty for many years.

Discretion has to be exercised according to the

temperament of the patient, as it is not everyone who is endowed with the dogged courage and determination displayed by the remarkable people I have referred to, and some relaxation must be allowed if the continuous silence produces a degree of depression which seems to do more harm than the silence does good. Speaking in a "silent" whisper is a reasonable compromise if the patient can be got to understand that the whisper must be really silent, which is not always an easy matter. The silent cough and the silent whisper are both worthy of consideration.

Though it is scarcely conceivable that the inhalation of an antiseptic vapour can have any considerable effect on the tubercle bacillus, the wearing of a respirator charged with creasote undoubtedly exercises a beneficial effect. I find the following "*guttæ cinnamomi co.*," which may be familiarly called "scented creasote," reasonably tolerable and efficacious in checking the cough, producing a certain soothing effect and possibly keeping talkative friends at a distance: *Ol. cinnamomi.*, *ol. citronell.*, of each 12 minims; *ol. pin. sylvest.*, *spir. chlorof.*, of each 1½ drachms; creasote, 3 drachms. A simple perforated zinc face-piece, such as that devised by Burney Yeo, meets the requirements very well, and after a little moulding can be worn for several hours at a time and even during a night's sleep. If the respirator seems at all suffocating there is no objection to cutting a hole of about the size of a shilling out of each side.

In any case of tuberculosis of the larynx it is well to have the nose cleared of catarrhal and especially purulent secretions. I once inquired of some patients, who had improved more than I expected, when they began to improve, and they said unanimously: from the time that I made them wash out their noses. This can be done by means of my snuffing douche tube, a glass tube of about 3 inches in length and with a flattened bulbous end to fit the nostril. The other end

is placed in a glass or egg-cup containing a mild antiseptic isotonic lotion from which it is sniffed up through the tube. Such a lotion is: Sod. salicyl., sod. chloride āā. gr. xlviij, sod. bibor. gr. xcvi, glycerine min. lxxii, aq. menthol (made like aq. camph.) ad ʒij. A teaspoonful in an ounce of warm water for the nose.

Beneficial as the freest access of *fresh air* is to the typical case of chronic pulmonary tuberculosis, I have a strong feeling that in the laryngeal cases the "wind" must be "tempered" and the patient kept away from the open windows if there is ulceration or, in general, pain of any degree of severity.

A *cough* which clears the bronchial tubes of septic secretions is to that extent "useful" and to be encouraged, but a dry tickling and noisy cough, without expectoration, is not merely "useless," but harmful. The patient should be ordered by the physician to resist the inclination to indulge in the dry and often "noisy" cough which depends only on irritability of the "cough spots," and the nurse should coax the patient to carry out this order, reminding him that the noisy cough "knocks the vocal cords to pieces" and tends to bring on ulceration. It may also be suggested that, as the Germans say, "You need not always scratch when there is a tickling." Coughs may be "noisy" or comparatively "silent," and with a little practice a large quantity of secretion may be brought up without much or any noise. The "useful" cough should be as "silent" as possible for the sake both of the patient and of those around him.

I have always thought that the ventricles were more frequently infected with tubercle in the early stages than has generally been stated. My reason has been that observation and experiment show that a forcible blast of air passing up the trachea enters the ventricles and forces the ventricular bands together after the fashion of dock-gates so arranged as to keep the water in. Secretions forced up in coughing will, therefore,

be caught in these cavities and will deposit in them such bacilli and cocci as they may contain. This view receives support from the investigations of Wotzilka and Adler, communicated to the recent International Congress at Copenhagen on the X-ray diagnosis of tuberculosis of the larynx. The observers describe appearances indicating the development of tuberculous infiltration in the ventricles even in cases in which the laryngoscope failed to find evidence of its presence.

The question then arises, how we are to introduce remedies into these backwaters, the ventricles. From the above it seems clear that if we inject liquids into the trachea they will in part be coughed up and driven into the said ventricles. The most obviously effective method is for the expert to inject the fluid into the larynx and trachea by means of an intralaryngeal syringe of such type as Bronner's or Watson Williams's (to the latter of which I have had an extra long tip adapted for the introduction of lipiodol when required).

There is, however, a simple method which the practitioner or nurse, or even the patient himself can carry out, namely, *the transnasal method*. This consists in pouring slowly into the nose about a fluid drachm of a bland medicated oil such as a one in twenty

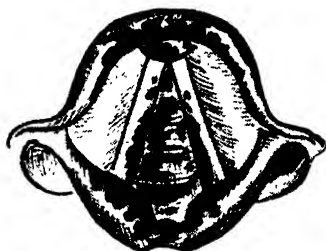


FIG. 4.

Fig. 4.—Methylene blue in oil, seen in larynx after transnasal instillation.



FIG. 5.

Fig. 5.—Powder seen in larynx after inhalation by Leduc's tube.

solution of eucalyptol in oil of sweet almonds, with the head thrown well back and the mouth open. The patient

takes deep panting breaths and makes every effort to avoid swallowing. If the oil is tinged with a little methylene blue it can be seen (Fig. 4) by the laryngoscope to have entered the larynx and even the trachea.

It is most important that *relief from pain in swallowing* should be obtained both from the local and general points of view. The pain as such is a source of misery and, if it is so intense that the patient avoids eating, a very serious loss of resistance ensues with rapid increase in emaciation and speedy dissolution. The following instance illustrates this point and at the same time emphasizes the value of the galvanocautery applied to a localized ulcer for the relief of pain, though only in the hands of an expert.

A young lady under my care with advanced laryngeal disease and comparatively quiescent pulmonary involvement was making good progress, certainly not losing ground. A week later she appeared looking thin and worn-out, as if she had taken a "turn for the worse." It was found that she had suffered so much pain in swallowing that she had almost given up food with consequent weakness and emaciation. I was able to localize a comparatively small ulcer on the left ary-epiglottic fold and applied the galvanocautery point. With a rapidity which was almost uncanny her pain vanished and she returned a week later looking as well as before, having been able to take her food once more without pain.

Far and above any other simple means of relieving pain arising from tuberculous ulceration of the larynx is the inhalation of a local anæsthetic (anæsthesin and orthoform, in equal parts) in the form of a powder by means of Leduc's tube. This consists of a glass tube about ten inches in length, one end of which is pushed to the back of the patient's throat, while the other is placed in a small saucer containing the powder to be inhaled. The end in the throat is curved downwards for about half an inch through an angle of  $60^{\circ}$ ; the opposite end is bent down for three inches so as to dip conveniently in the powder. The lips are compressed firmly round the tube, and if a sharp sucking inspiration is made, some powder is drawn into the larynx. Fig. 5 gives a good idea of the distribution of the powder in

the larynx after inhalation.

Occasionally we find a patient on whose larynx the powder has an irritant action. An emulsion containing menthol and anæsthesin is then sometimes effectual. It is made as follows: Menthol, 24 grains; pulv. gumm. acac., ol. amygdal., aq. dest., of each  $2\frac{1}{2}$  dr. *Fiat emulsio et adde*: Anæsthesin,  $1\frac{1}{2}$  dr.; sp. vin. rect., 10 dr., aq. dest., 2 oz. Mix and shake well. It may be swallowed or applied to the larynx by means of a curved brush or by the transnasal method. Unfortunately anæsthesin and orthoform are not soluble in liquids suitable for spraying except to such a small extent as to be almost inert.

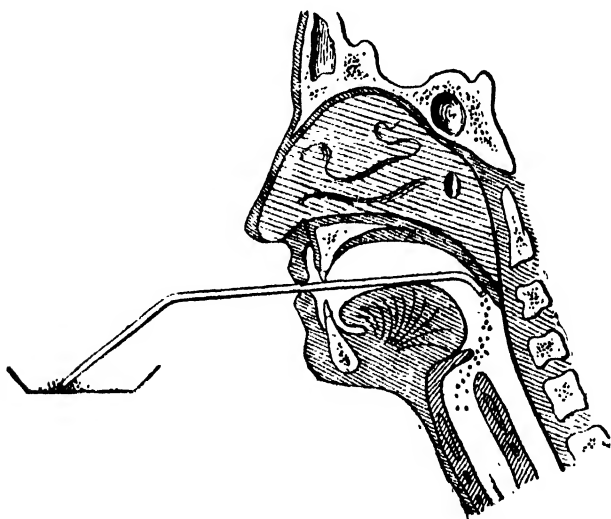


FIG. 6.—Leduc's tube for powder inhalation.

Leduc's tube is excellent for the inhalation of all healing powders, of which one of the best is diiodoform (Adrian, Paris).

Among our most valuable ultimate resources in the treatment of pain in swallowing must be included *blocking the superior laryngeal nerve with alcohol*, a proceeding which is easily carried out by the specialist but which "on a pinch" the practitioner might

perform without much difficulty. A two cubic centimetre syringe with a needle about twice the thickness of an ordinary hypodermic one, more obtusely bevelled at the point and furnished with a groove at a distance of one centimetre and a half from the tip, is all that is necessary. The solution I use is the one devised by Sir James Purves-Stewart for the fifth nerve, and consists of 2 grains of hydrochloride of eucaine in 1 ounce of 80 per cent. alcohol. The *modus operandi*, as I practise it, is as follows :

The patient is placed in a semi-recumbent or horizontal position and the operator stands on the side on which the injection is to be performed. The neck is sterilized with tincture of iodine or alcohol and the operator's hands with alcohol. I then pass my left hand over the patient's chin and grasp the larynx with my left thumb and fingers, pulling the larynx toward me with the fingers and feeling for the thyro-hyoid space with the thumb, noting a spot about one centimetre in front of the tip of the great cornu of the hyoid bone, or directly above the oblique line for muscular attachment on the thyroid cartilage, and close above this cartilage. The needle, detached or else fixed upon the syringe, is inserted perpendicularly to the skin to the depth of about a centimetre and a half, varying slightly according to the thickness of the superjacent soft tissues. If blood comes from the needle this should be withdrawn and reintroduced at a slightly different spot. The syringe, if detached, may now be screwed on and a few drops of the alcohol should be injected. This generally causes slight smarting and the patient is instructed to raise the hand when the smarting stops. One c.cm. or a little more may then be injected. In order to make sure that there has been no penetration of a vein, the syringe, if attached, may be screwed off and then re-adapted, or a very gentle aspiration may be made, to see whether a drop of blood passes into the syringe.

If the injection has been successful the patient, when asked after a couple of minutes to swallow, will do so expecting to have the usual pain, but instead of making a wry face he will break out into smiles. The relief afforded often lasts for weeks.

It may be remembered that the epiglottis has less of its nerve-supply from the superior laryngeal and more from the glosso-pharyngeal nerve than the rest of the larynx, so that in pain from ulceration of the epiglottis the results of this injection are not so certain as when the disease is situated in the other parts of



the framework of the larynx. Fortunately the epiglottis receives the anæsthetic powder in full blast and is freely accessible for treatment by means of the galvano-cautery or for removal, in whole or in part, by means of punch-forceps.

The most urgent, though infrequent, call which the practitioner has to meet is to afford relief from *regurgitation of liquids* during drinking though, much more often, from pain in swallowing. For regurgitation we are fortunately able to counteract the difficulty to a great extent by the adoption of "Wolfenden's method." For this the patient lies on his face, lowers his head over the side of the bed or foot of the couch and drinks from a cup through an indiarubber tube. The delight expressed by the patient after a long draught taken in this way is often quite dramatic. "The best drink I have had for a month" is not infrequently the description given by the patient. This proceeding is often overlooked, and it is so valuable that I have no hesitation in dwelling on it to an extent which may seem to border on exaggeration.

I have known patients improve so much after the institution of this mode of taking nourishment that the larynx has recovered sufficiently to be able to close and to make drinking possible in the ordinary way.

*Laryngeal obstruction* indicated by stridor on inspiration, and sometimes on expiration as well, is fortunately not a usual feature in a disease where loss of substance rather than proliferation is more common.

As a rule it develops gradually so that before it reaches acutely dangerous proportions its onset can be anticipated. It may sometimes be staved off by increased rigor in the carrying out of the general treatment, both medicinal and hygienic, with which the practitioner is familiar. Absolute rest in every form, attention to the nose and avoidance of

every form of irritation, are among the chief measures.

If the time comes when the obstruction becomes threatening or severe, the practitioner may have to perform tracheotomy to afford relief, though this, unfortunately, is too often the beginning of the end, as the lung condition does not usually answer favourably to the entrance of air which has not been filtered and warmed by passing through the nose or even the mouth. The operation does, however, give great relief from the agony of suffocation.

It has not been attempted in this article to discuss all of the many possible methods of treatment, but it is hoped that this purely practical description of those which have been tried and proved will be helpful to the busy practitioner.

# The Importance of Laryngoscopy in the Diagnosis of Pulmonary Tuberculosis

By R. SCOTT STEVENSON, M.D., F.R.C.S.E.

*Senior Assistant Surgeon to the Metropolitan Ear, Nose and Throat  
Hospital.*

THIS short article is intended to emphasize to physicians and general practitioners the importance of examining the larynx when attempting to come to a conclusion in the diagnosis of pulmonary tuberculosis. I raised the point previously, in 1929, at a joint discussion between the Sections of Tuberculosis and Laryngology of the British Medical Association at Manchester. I said then, with considerable diffidence in such a meeting, that my experience had led me to realize that while practitioners were accustomed to inquire about the family history and the early symptoms of pulmonary tuberculosis from a patient, make a competent examination of the chest for physical signs, have the lungs X-rayed, keep a careful temperature chart, have the sputum examined and make (on occasion) cutaneous tests for tuberculosis, they seldom seemed to take a look at the larynx or have it examined by a laryngologist, yet this not infrequently would give them as much information as all the other methods of diagnosis put together.

The truth of this statement seemed so self-evident that I did not pursue the subject at the time. After

all, in Osler's textbook of medicine it is pointed out, in discussing the diagnosis of pulmonary tuberculosis, that "the group in which throat and larynx symptoms precede the manifestations of pulmonary tuberculosis is a very important one."<sup>1</sup> I have recently, however, encountered a number of cases that compel me to return to it, to beg practitioners to remember that examination of the larynx may clinch the diagnosis of pulmonary tuberculosis beyond the shadow of a doubt, and to repeat the dictum of Chevalier Jackson that no patient should be allowed to remain hoarse for three weeks without having the larynx examined by a competent observer.

*Case 1.*—G. B., a young man, aged 31, consulted me because he was very hoarse and had a lecture to give that night. On inquiry, I found that he had been hoarse for five months. His practitioner told him that he had a "nervous throat," and was treating his nerves; his chest had been examined by four different doctors, as he had not felt satisfied about his lungs, but all of them had assured him that there was nothing the matter with them. He had no cough, but he thought he had lost a little weight. His sputum had been examined, with negative results.

One glance at his throat revealed the condition shown in Fig. 1: tuberculous infiltration of the arytenoids and ulceration of the left vocal cord. A cocaine spray helped the patient through his lecture, and arrangements were then made for him to enter a sanatorium.

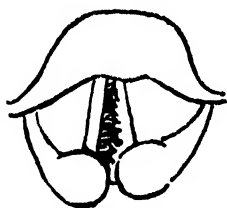


FIG. 1.

*Case 2.*—A. M., a young man, aged 30, was sent to me by a physician for examination of his larynx. He had had influenza six months previously, and hoarseness came on soon after that. He was coughing up a lot of sputum, and the physician said that he considered the chest suspicious, but that there were no definite signs of pulmonary tuberculosis. He brought a letter from his own doctor, who said that he thought the throat condition entirely nervous, because the patient had no trouble in swallowing solids, but swallowing liquids always brought on a fit of coughing.

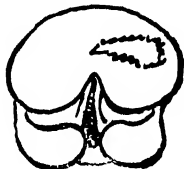


FIG. 2.

Fig. 2 shows the condition of the larynx: tuberculous infiltration of the arytenoids, turban-shaped infiltrated epiglottis, and tuberculous ulceration of the epiglottis—almost too advanced for treatment even in a sanatorium. The reason why solids were swallowed easily, but not liquids, was obviously

because the bolus of food slipped over the immovable epiglottis while liquids fell into the larynx.

**Case 3.**—F. W., a young woman, aged 22, was sent to me by her doctor for examination of the throat; he considered that the unhealthy tonsils which were present might be causing her ill-health. She had been examined by a tuberculosis officer, but her chest was pronounced free of any signs of tuberculosis. This patient had been hoarse for six weeks, and she was always tired; no other symptoms.

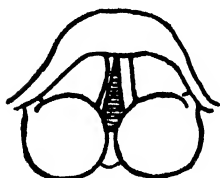


FIG. 3.

Fig. 3 shows the condition of the larynx: marked tuberculous infiltration of the arytenoids and of the right ventricle.

**Case 4.**—M. A., a young woman, aged 26, was sent to me by her doctor because she had twice or thrice spat blood. She played a wind instrument in an orchestra, and the doctor considered that the blood came from some engorged veins on the posterior wall of the pharynx and that the bleeding was caused by blowing the instrument. The patient said that she had felt very tired for the previous three months, but had no other symptoms except occasional attacks of coughing. She stated, however, that the blood she spat up was bright red and that it came up without much effort; this statement alone should have been almost pathognomonic of pulmonary tuberculosis.

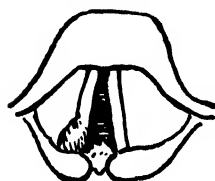


FIG. 4.

The condition of the larynx is shown in Fig. 4: swelling of the left vocal process (a characteristic lesion of laryngeal tuberculosis), with a tuberculoma of the inter-arytenoid space. Examination of the lungs by a physician and X-ray examination of the chest both proved negative, but cutaneous tests were strongly positive for tuberculosis, and the evening temperature was raised.

It may be taken as practically certain that *all* cases of laryngeal tuberculosis are secondary to pulmonary tuberculosis. H. Barwell,<sup>2</sup> who has had a very wide experience of this disease, states that primary laryngeal tuberculosis is "extremely rare, but does undoubtedly occur." To support this opinion, however, he quotes (in 1928) three cases from German literature, one reported in 1882 and two in 1887—evidence that can hardly be taken as incontrovertible to-day.

The recognition of most cases of laryngeal tuberculosis is not difficult, though it must be remembered that all affections of the larynx in consumptives are not necessarily tuberculous. Early symptoms of laryngeal disease, such as a slight alteration in the

voice or a tendency to clear the throat frequently, may appear before hoarseness, and a persistent laryngeal catarrh should call for examination of the larynx. The posterior part of the larynx is the most commonly affected, from the stagnation of secretion in the region of the posterior commissure, and it is here that one is accustomed to look for the earliest signs of tubercle. The most usual early signs are thickening or ulceration of the inter-arytenoid region or swelling of the area immediately above the vocal process. The middle and posterior thirds of the vocal cords may show slight injection, rounded swelling or, later, ulceration. Infiltration, "pseudo-œdema" and ulceration of the arytenoids, ary-epiglottic folds or epiglottis are late signs, and the outlook in such cases is bad.

StClair Thomson<sup>3</sup> has expressed the opinion that no case of laryngeal tuberculosis can be looked upon as "slight," and that the presence of a laryngeal complication in pulmonary tuberculosis darkens the prognosis at all stages. Nevertheless, the prognosis is better than it used to be—Morell Mackenzie<sup>4</sup> in 1880 said that it was not certain that any case of laryngeal tuberculosis ever recovered—and it would be better still if, by examination of the larynx, the pulmonary disease and the laryngeal lesion were discovered at an earlier stage.

### References.

<sup>1</sup> McCrae, T.: "Osler's Principles and Practice of Medicine," 1925, p. 192.

<sup>2</sup> Barwell, H.: "Diseases of the Larynx," 1928, p. 80.

<sup>3</sup> Thomson, Sir StClair: "Tuberculosis of the larynx; ten years' experience in a sanatorium." *Medical Research Council Special Report*, No. 83, 1924, p. 9.

<sup>4</sup> Mackenzie, Morell: "Diseases of the Throat and Nose," 1880, vol. I, p. 383.

# Concealed or Unobserved Mastoiditis

By RICHARD WARREN, M.D., M.Ch., F.R.C.S.

*Surgeon to the Weston-super-Mare Hospital; late Surgeon to the  
London Hospital.*

**I**NFLAMMATION of the mastoid antrum and surrounding cells is by far the most important feature in suppurative disease of the middle ear. The infected middle ear when draining by the Eustachian tube or by a perforation of the tympanic membrane can probably deal with the greater number of infections of its mucosa without the latter spreading to the underlying bone and causing caries. The mastoid antrum on the other hand, which I believe is always infected in otitis media, with its thin mucosa and general inability to drain readily, is liable to remain infected, and should the aditus to the middle ear become blocked by œdema, polypi, etc., the infection readily spreads to the bony wall of the mastoid and thence to (1) neighbouring parts, such as the meninges, brain and lateral sinus, or (2) the system generally, as bacteriæmia or pyæmia.

In most instances the mastoid is infected by way of the Eustachian tube and middle ear in an ascending manner. Primary mastoiditis as a blood-borne infection, either pyogenic or more likely tuberculous, occurs occasionally. I suspect that a good many cases, where the mastoid flares up rapidly, in the apparently early phases of otitis media, are really of old standing, there being adequate drainage via the Eustachian tube, or a perforation in the drum to avert temporarily the catastrophe; or the infection may possibly remain quiescent and latent like a chronic abscess of a long bone (Brodie's abscess). Many cases of suppurative otitis

media, and presumably mastoiditis, are quiescent, there being little discharge so that the patient may not seek medical advice and thus escape notice till the flare-up takes place.

*Local signs.*—It is important to realize that local signs are often slight or absent; œdema over the mastoid with displacement of the ear forwards is definite evidence that the case is not an early one. Those who wait to diagnose mastoiditis till œdema on the surface appears will neglect many cases which need operative treatment. Pain and tenderness over the tip of the mastoid are important, but not constant, appearing and disappearing in such a way as to delude the observer into the belief that the condition is not severe. Œdema of the posterior wall of the deeper (bony) part of the auditory meatus seen when inspecting the membrana tympani has long been noted by otologists as an important sign: more often in the cases met with the œdema has spread all round the meatus making it impossible to get a good view of the drum. In such cases the mastoid should always be explored. Further, a furuncle in the meatus may be mistaken for mastoiditis if care be not exercised; but one must also remember that furuncles are likely to occur in the presence of otorrhœa and may be associated with a severe mastoiditis. In brief, one's mental attitude when dealing with a case of otorrhœa should not be: "Why should I operate on this case?" but "Dare I leave this mastoid unexplored?"

*General signs.*—Vague general seediness with or without pyrexia, headaches, and drowsiness, associated with a discharging ear, are signs urging that the mastoid trouble is advancing and may shortly lead to the more serious complications mentioned above. In one instance hæmaturia brought the patient into hospital and this proved on exploration to be due to very extensive mastoiditis with wide destruction of bone. Opening the mastoid early is the surest way of



avoiding the tragic intracranial complications.

#### VARIETIES

(1) *Early cases*.—This means cases encountered within a few days or weeks of the primary attack of otitis media. As pointed out above many cases brought up as early are really exacerbations of unrecognized or concealed suppurative otitis media and mastoiditis of months' or years' duration. Especially in children the combination of a small and swollen meatus or furuncles often makes an accurate examination of the tympanic membrane difficult. In this group, the cases are obviously ear cases and the question is how soon and for what indications, after the drum has been perforated or burst, it will be wise to open the mastoid. Where the ear is discharging freely and yet there is pain or pyrexia, tenderness or malaise, there should be no hesitation in opening the mastoid at once even though the otitis has only lasted a few days. On the other hand, where there are no untoward symptoms whatever after the drum has been opened (or burst) one may reasonably delay a few weeks in case the condition may clear up with natural drainage and establishment of immunity. After four to six weeks, if the condition persists unchanged, the safest policy will be to open the mastoid as there is no other way of ascertaining how far the infection has spread into the cancellous bone surrounding the mastoid antrum. There is often a far wider spread of osteitis than would be imagined from any signs that are to be found on examination, and it is this spread in the bone which makes the condition serious and in part accounts for the length of time some of these cases take to heal after operation.

(2) *Late cases*.—These include the bulk of those met with in ordinary surgical practice; because as a rule there is a tendency to wait indefinitely when a patient has a discharging ear. It is not easy to state categoric-

ally, that on such a day or week operation becomes definitely indicated, and unless severe symptoms develop such cases are apt to drift. This dilatory policy accounts for much of the difficulty met at operation and for not a few unsatisfactory results. My impression is that if the general rule was always to open the mastoid in cases of otorrhœa with unhealed perforation and discharge within at most six weeks it would only be necessary to remove a small amount of bone, finishing the operation after the manner of Heath's conservative mastoidectomy draining through the auditory meatus enlarged by a plastic operation.

It is the long delay so commonly allowed which leads to such changes as great thickening of bone over the mastoid, wide-spread infection of surrounding cancellous bone, to say nothing of such things as intracranial complications which render necessary the very wide removal of bone, leaving a great chasm which takes so long to heal by granulation and papering the inside with epidermis that the enlarged external meatus is liable to contract awkwardly and render dressing difficult.

*The operation.*—The mastoid antrum is the key to the situation and must always be defined by noting the passage of the adit forwards to the attic of the middle ear. As a rule this is not difficult if its anatomical position behind the upper posterior quadrant of the bony meatus be remembered. But when the bone is very much thickened, especially in adults, the antrum may lie the best part of an inch from the surface and it may be impossible to avoid encroaching on the middle fossa of the skull or the groove of the sigmoid sinus before it is found. This opening into the cranium is of little harm if done with circumspection and may, in bad cases, give valuable evidence on the state of the dura and sigmoid. The antrum has on occasion been found above the level of the floor of the middle fossa (at its lateral limit) and behind the

front edge of the sigmoid sinus.

More commonly, however, one opens into cancellous bone containing pus and granulations in its spaces. Removing these and tracking up fistulæ which exude pus one arrives at the antrum which is known by passing a small probe gently into the adit. The next stage is to thoroughly remove all diseased bone, since a failure to do this completely is I believe the commonest cause for relapses after operation or failure for suppuration to cease.

Nor is the matter always easy, for groups of suppurating cancellous cells having fairly thick healthy-looking walls may communicate by tiny fistulæ with the main cavity. It is necessary to pick and probe with a fine instrument all over the interior of the cavity before the presence of a sequestrum can be eliminated. Sometimes in so doing one traces a fistula through into the interior of the cranium and thus may drain an extradural abscess which has been lurking there.

*Methods of concluding the operation.*—Having now removed diseased bone, opened up fistulæ and rendered the cavity as regular and smooth-walled as possible, the next question is how to conclude the operation. It is the old proposition of how best to cause a cavity in bone to heal. To some degree this is possible by sloping the edges of the pit so that the depression becomes saucer-like enabling the overlying soft tissues and integuments to subside to the bottom of the cavity. But this is only possible to a limited degree, for in the deeper mastoids efficient saucering would encroach to an impossible extent on the middle fossa of the skull and the sigmoid groove. There are several methods possible.

(1) Leave the incision behind the ear wide open or nearly so and pack to the bottom gradually diminishing the pack as the bone cavity granulates, scar tissue is formed, and epidermis grows over from the edge of the operation wound. This plan is safe but will leave an ugly wide depressed scar covered with thin epidermis. It

is useful for the more severe type of case where much bone has to be removed and perhaps the interior of the skull drained.

(2) Partially or almost completely close the operation wound packing through a small opening for a few days then remove packing entirely and allow to heal. The difficulty is to know when to leave out the packing and let the wound close. A good many cases will heal under such treatment, but there is always a considerable chance that the mastoid will be filled not with healthy scar tissue but with granulations of a poor type which, ultimately, break down forming a fistula behind the ear.

(3) More cosmetic results may be obtained by closing the operation wound behind the ear completely and draining through the meatus which is enlarged by a plastic operation. There are two main types of this operation: (A) the radical (Stacke), the (B) conservative (Heath).

(A) In the radical operation, after clearing diseased bone from the mastoid and its surroundings the "bridge" i.e. the bone remaining between the bony meatus and the opening into the mastoid is removed thus causing the mastoid adit and tympanic cavity to form one large cavity, the remains of ossicles and drum are removed.

(B) In the conservative method of Heath, at a similar point in the operation the "bridge" is also removed but only in part—namely, down towards the tympanic membrane as far as may be deemed safe. After this the procedure is much the same, viz., the cartilaginous meatus is slit up into the concha from which a single or double flap is fashioned and turned inward so that the remade meatus is an opening about  $\frac{3}{4}$  inch in diameter leading down to the tympanum and mastoid. The opening is kept wide by a large tube for some days and the cavity carefully packed and dressed. The mastoid cavity becomes healed partly by falling

into the overlying soft parts, partly by ingrowth of epidermis from the edge of the slit meatus and concha and may be accelerated if necessary by skin grafts.

The fate of the tympanic cavity differs in the two types of operation. In the radical operation the interior of the wall tympanum becomes epidermized by regeneration of its own mucosa or by spread of epidermis from outside as in the case of the mastoid cavity. In the conservative operation in which the drum and ossicles have been left intact the middle ear usually recovers once the active infective agent in the shape of the suppurating mastoid has been scotched: and assisted by occasional Politzerization the perforation, if not too extensive, will heal and the ear be restored to something like normal. Should the conservative operation fail it can readily be converted into the radical by removing the rest of the bridge and ossicles. But I am inclined to think that unsatisfactory cases are far more often due to some unobserved focus in the mastoid than to the middle ear persisting to suppurate once the mastoid has been thoroughly healed and, therefore, one is more likely to have to attack the mastoid again than to open up the middle ear. The conservative operation will be one's choice when the case is early and the drum and ossicles not hopelessly disorganized. When in doubt it can be done as a tentative measure and later converted into the radical type by simply removing the rest of the "bridge." It has the advantage over the more primitive methods 1 and 2, that the cavity of the mastoid and adit can be kept under observation till healed and that the enlarged meatus allows a better view of the tympanum in cases where the normal meatus is small. Skilled and careful dressing is very essential in these cases, as without due care there is considerable risk that the enlarged meatus may become narrowed and distorted so that it may not be easy to keep the whole of the mastoid cavity (if

large) under observation.

#### CONCLUSIONS

(1) Inflammation of the mastoid mucosa occurs in practically all cases of middle-ear suppuration.

(2) From this infection of the surrounding bone readily arises.

(3) This may be latent except for otorrhœa which may be of such slight amount as to be disregarded by the patient.

(4) The symptoms otherwise may be mostly general varying from malaise, anorexia, slight irregular pyrexia, hæmaturia, in the less urgent cases, to a typhoidal condition in cases where the more severe intracranial complications are present.

(5) Following incision or perforation of the drum there should be complete relief of all symptoms with the exception of otorrhœa. Any departure from the normal, such as pain or pyrexia, should be regarded seriously and the question of opening the mastoid raised within a day or two.

(6) Persistent otorrhœa nearly always means that the mastoid antrum is infected and cannot heal of its unaided efforts: further, caries and osteomyelitis of the mastoid process are often present, although local and general signs may remain in abeyance for a long time. Hence the safe rule is to open the mastoid within a few weeks of the primary otitis; it is surprising how much wider the bone disease is than would have been expected from the signs and symptoms.

# Mastoiditis, Its Diagnosis and Treatment

By H. NORMAN BARNETT, F.R.C.S.E.

*Surgeon to the Bath Ear, Nose and Throat Hospital.*

THE practitioner may rightly complain that he is without a rudder in a difficult sea when considering the subject of mastoiditis. The nomenclature has changed in its significance, and the old is used alternatively with the new, till the subject has become a very confused one. To gain a clear understanding it will be necessary first to consider the acute affection of the tympanum or middle ear. This usually has its origin in microbic infection of the naso-pharynx, and gains admission by the Eustachian tube. It sets up inflammation and is known as otitis media; whether this is designated as "dry," "moist," "catarrhal," "acute," "chronic," or "suppurative" makes little difference, for all are different steps or signs of the same condition, and it is exactly like inflammation anywhere else with its varying signs of "resolution," "ulceration," and "suppuration," only differing in the fact that it occurs in a small bony chamber lined with mucous membrane, which is walled on the outer side with an opaque substance, the tympanic membrane, which is liable to burst from internal pressure and a passage in the upper part of its inner wall—the iter—into the antrum of the mastoid bone. If these facts are appreciated, and the

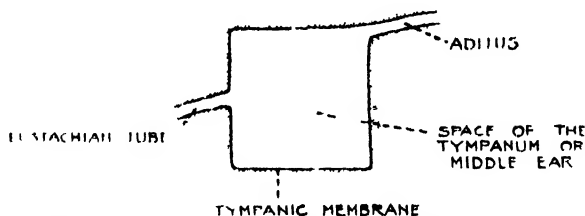


FIG. 1.—Diagram of the tympanic tract (magnified two and a-half times).

mass of confused and meaningless terminology banished from his mind, the practitioner will understand the subsequent events with clearer understanding, and by easy deduction will make his diagnosis.

When inflammation is set up in the middle ear by infection through the Eustachian tube, pain is produced by the swelling of the mucous membrane lining the chamber. If prompt measures are now taken by means of such a remedy as warm colloid silver drops, the inflammation may subside; if, on the other hand, the infection is of a very acute nature, or is allowed to proceed without interference, the pain will increase and secretion will take place from the mucous membrane, gradually increasing in amount till the small space of the tympanum is filled and pressure exerted on the tympanic membrane.

A great deal will now depend as to subsequent events on the strength of the membrane; if it is thick and strong, the products of inflammation will tend to find their way towards the mastoid antrum, and mastoiditis is set up; if the membrane is not strong, the pressure from within will cause perforation, and middle ear discharge is set up.

It may at once be stated that the size of this chamber under consideration is so small that it is quite incapable of holding any quantity of pus. It will, therefore, at once be seen how inaccurate it is to say that a person is suffering from middle ear disease only when a profuse discharge comes and continues to come from the ear. There is no room for this material in the tympanic cavity, and the only place it can come from is the mastoid antrum and cells.

If extension to the mastoid has occurred, the patient should be considered as suffering from a serious disorder, and should be confined to bed, or at least to the house, wearing a flannel otitis media cap such as Heath's, while warm drops of  $\text{H}_2\text{O}_2$ , followed by 1 in 60 carbolic in rectified spirit should be put into the



ear every three hours. This should be combined with general constitutional treatment according to the intensity of the infection.

Where it is considered that there is not sufficient

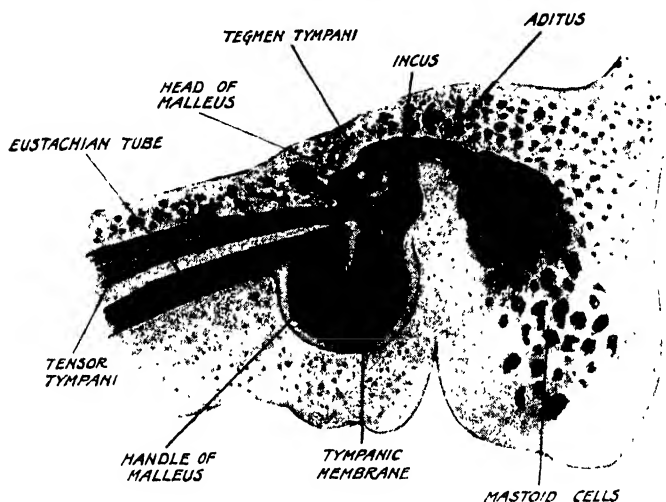


FIG. 2.—Diagram of the tympanum.

drainage taking place, the perforation should be enlarged, preferably by an incision of a semilunar shape made in the lower part of the tympanic membrane. Such methods as these will, in the great majority of cases, lead to a subsidence of the symptoms, and the patient will recover. If the discharge persists after the acute symptoms have passed off, zinc ionization should be given, taking minute care to cleanse the middle ear so far as possible, and the external auditory meatus before administration.

If the tympanic membrane does not give way, pain will increase and the temperature rise. If the tympanic membrane be examined it will be found to bulge outwards and to be bright red in colour. No time should now be lost, but after general anæsthesia a free semilunar incision should be made along the lower border of the membrane with the concavity downwards. This will usually lead to a rapid diminution of constitutional symptoms and instant relief of

pain.

The nature of the discharge, whether after perforation or incision, will depend upon the intensity and nature of the originating infection and the time that inflammation has been going on. Thus it may be serous, blood-stained, or pustular.

If the tympanic membrane does not perforate, is not incised, or the inflammatory processes have been very acute and rapid, the secretion will more or less rapidly, sometimes with tragic rapidity, find its way back through the iter and set up inflammation in the antrum and cells, including the tip cell, thus producing acute inflammation of the mastoid, which, if limited to the mucous membrane lining, may resolve if rapid and urgent measures are taken to ensure free drainage and disinfection of the middle ear and external auditory meatus; but these steps are seldom taken in time; and, even if they are, do not as a rule save the further stage of bone disease taking place, having in mind the inferior type of lining of the antrum and cells and the poor blood and nerve supply. If this occurs, we then have the condition of acute mastoiditis.

The symptoms of this condition as described in almost all textbooks are misleading in the extreme, and have led to mistakes in diagnosis and loss of life. The impression created in the mind of the general practitioner is that the outstanding feature of acute mastoiditis is a more or less large swelling behind the ear which pushes the ear forward so that it is much more prominent than its fellows. The illustration taken from a photograph of a case recently admitted to the Bath Ear, Nose and Throat Hospital is an example of the state. Such a condition should never be seen, with the possible exception of a case due to a fulminating type of influenzal infection which occasionally produces such symptoms in twenty-four hours, any more than an appendical abscess is expected to be seen before a diagnosis of appendicitis is

made.

It is sufficient that there should be pain with tenderness on pressure over the antrum or tip cell combined with a discharge too profuse to come from



FIG 3.—Illustration of acute mastoiditis.

the cavity of the tympanum, and therefore, as previously pointed out, coming from the mastoid area and varying in character according to the time it has been present. Some consideration also should be given to the constitutional reaction, as there may be considerable rise of temperature with malaise, but *it cannot be emphasized too much that an acute mastoiditis with considerable destruction of bone may be present with little or no constitutional symptoms*, or, again, that the latter may rapidly pass off, although there is advancing bone disease of the mastoid. This constitutes one of the dangers of failure to diagnose the condition present.

If then a case presents itself with the history that

there had been some pain for one or two days, followed by a discharge from the ear which still persists, and has the character above mentioned, and there is found to be some pain with tenderness opposite the centre of the external auditory meatus or at the extreme tip of the mastoid process with or without constitutional symptoms, the case should be kept under observation as a probable mastoiditis. The treatment adopted should be confinement to bed with disinfection of the middle ear, and counter-irritation behind and in front of the ear with the application of warmth by means of three layers of cotton wool under an otitis media cap, and promotion of efficient drainage if necessary by enlarging the perforation of the tympanic membrane.

If the condition does not clear up with almost complete cessation of discharge within a few days, an exploratory operation should be carried out. It is the failure to do this that comprises one of the great mistakes in handling mastoiditis at the present time. In the vast majority of cases failure to operate will lead to a long period of quasi-convalescence at the end of which there may be a temporary cessation of discharge and the patient will be discharged from observation on the assumption that he has been suffering from an acute middle ear disease and that he is now cured: the truth being that he has been discharged with a more or less quiescent osteitis or osteo-myelitis present, to reassert itself on a subsequent occasion as a discharge from the ear, when the case will probably be labelled as chronic suppurative otitis media. In reality it has now become a chronic mastoiditis with the middle ear acting as an effluent drainage tube for a diseased mastoid bone.

If operation is decided upon at the proper time, and the mastoid antrum opened, the subsequent steps taken will depend upon the condition found, but generally speaking the type of operation to be carried

out will be what is usually described as a modified Schwartz. In reality, however, it is a much more extensive procedure than that originally described by Schwartz. All diseased bone should be removed, even if it involves uncovering the lateral sinus and the dura mater and carrying the removal as far as the tip cell of the mastoid process. It is sometimes advised that the tip itself should be removed, but this is not usually necessary or advisable. All diseased bone having been got rid of, the middle ear should be washed out, by a small tube placed in the iter attached to a bulb, with normal saline, thus getting rid of a large amount of debris and pus from the cavity of the tympanum and shortening convalescence materially. The bone cavity may now be dealt with in various ways. If there has been a great deal of pus and caries, the cavity may be touched with pure carbolic acid; if the condition has been found to be more necrotic, and there has not been much pus, the space may be allowed to fill up with blood to form a blood-clot, or it may be filled with colloid silver. If no pus has been present and the case is one of bone degeneration, the wound may be left without any chemical, and the posterior wound completely stitched up without drainage; but in the former two types it is better to leave out the bottom stitch and insert a gauze or tube drain which may be removed in forty-eight hours. In some cases, where the bone is dry, an alternative of B.I.P. dressing may be used, and here again the posterior wound may be completely closed. An external dressing of white sterile gauze steeped in hot normal saline solution, thick layers of cotton wool and a firm bandage covered with a mastoid cap (Bath Ear, Nose and Throat Hospital pattern) completes the operation. If the patient is comfortable and there is no rise in temperature, the dressing may be left three days; in cases where the posterior wound has been closed and the general condition is satis-

factory, the case need not be dressed for a week.

There are certain atypical cases about which the practitioner should be on his guard. They comprise those in which there is little or no swelling or pain over the mastoid, but in which there is tenderness and swelling in front of the ear or in the neck, and these in my experience are amongst the worst types of acute mastoiditis. There are also those which, having the characteristics just mentioned, have no discharge from the ear; or, again, there are those which have tenderness and swelling over the mastoid, but no discharge from the ear. Where the swelling is anterior or inferior to the mastoid, pus is finding its way from behind, and is usually found in young and cellular bone. When no discharge is coming through the external auditory meatus, it must be remembered that it is probably finding its way in other directions, and the danger of this should be remembered in view of the anatomical arrangement of the middle ear, as a brain abscess is more likely to develop either in the temporo-sphenoidal lobe or in the cerebellum. The question of brain abscess is a large one which cannot be entered into here, but it must be emphasized that this disastrous complication is always a possibility in suppurative conditions of the middle ear tract, and frequently there is little or no warning of its onset. It may show in what appears to be a particularly acute mastoiditis, or it may be that there is a free discharge, or, again, where there is no discharge at all.

Should a case first come under observation when a discharge from the ear has been present for a long time, either continuously or with intervals of cessation, probably not real, but in the patient's opinion so, or when the discharge has been the outcome of an acute mastoiditis which has not been treated effectively by operative or other measures, we are dealing with a condition of chronic inflammation of the mastoid antrum and cells, namely chronic mastoiditis, *although*

there may be no other symptoms than that of a discharge from the external auditory meatus. This constitutes in nearly every case the "running ear"<sup>1</sup> of everyday experience, and is the condition usually put down to and described as chronic suppurative otitis media and uselessly treated by means of drops in the external auditory meatus.

The treatment in such cases where there is no danger sign, should be to thoroughly disinfect the ear with 10 vols. warm peroxide of hydrogen and 1 in 60 carbolic in spirit used several times a day. If this within a week does not produce abatement, zinc ionization should be tried in the external auditory meatus, first having carefully cleaned the ear, with ether if necessary. If, after application of this for, say, six treatments, the discharge has not abated and other symptoms persist, an operation should be carried out on the mastoid, and the best type is a modified radical.<sup>2</sup>

This operation removes all diseased bone, but leaves the functional apparatus of the middle ear. It provides, however, a route whereby the middle ear can be washed out from behind, and treated in such a way that this chamber recovers its normal condition. The result is that, in favourable cases, the patient has been relieved of a dangerous disease—chronic mastoiditis—and his hearing improved and usually, restored to normal. Such an operation should, in the majority of cases, be undertaken in preference to the old fashioned so-called radical mastoid, since it achieves the purpose of the latter with, as a rule, better surgical results and, in addition, saves the function of hearing, and because of this will be much more readily submitted to by the patient.

#### References.

<sup>1</sup> Barnett, H. Norman : "The Running Ear." *Brit. Med. Journ.*, ii, 1929.

<sup>2</sup> *Idem.* : "Modified Radical Mastoid Operation." *Proc. 1st Congress International D'Oto-Rhino-Laryngologie.*

# Speech Disturbances in Cases of Parkinsonism

By E. STOLKIND, M.D.

*Late Assistant Physician to the Moscow Municipal Hospital.*

THIS is a brief account of an investigation of the speech defects in Parkinsonism or post-encephalitic paralysis agitans, the most common sequel of epidemic encephalitis. It is the first attempt to use both the graphic method of recording the speech in this disease and examination of the soft palate and vocal cords as well as the usual investigation by ear. Peculiar speech defects are among the pathognomonic signs of Parkinsonism; they may even be the first to appear, and in this event have led to an incorrect diagnosis; thus some of my patients in whom the speech defects appeared in advance of other signs, had been treated for these by removal of tonsils and adenoids or even of all their teeth before Parkinsonism was recognized.

In the differential diagnosis it is important to bear in mind the speech disturbances in other nervous diseases, e.g. in pronounced cases we can distinguish by the ear alone the scanning speech of staccato character in disseminated sclerosis; the thick, slow, irregular "hot-potato" speech in Friedreich's ataxia; the indistinct nasal disarticulate speech in progressive bulbar paralysis; the stumbling, slurring speech in progressive paralysis of the insane. The speech is also pathognomonic in other cortical lesions (aphasia) as well as in hysteria (aphonia). There was slow, hesitating speech in a case of chronic medullary poisoning which I described in 1926. Also, in many cases of epilepsy the speech, especially in reading or reciting, is monotonous, expressionless and peculiarly high and



can be recognized with practice.

In Parkinsonism the speech varies, either with or independently of the course of the disease, and can be described as low, slow, hesitating, monotonous or tiresome, drawling, jerking, often incomprehensible. There have also been cases of palilallia as well as of complete mutism. The following cases may illustrate the common speech defects in Parkinsonism :—

A man, aged 23, is mostly silent; the speech is slow, monotonous, incomprehensible. His mouth is open, the movements of the tongue very slow, and there is great difficulty in opening the mouth wide and in putting out the tongue. The movements of the soft palate are limited, and those of the vocal cords were normal at the first examination, but on re-examination the tension was reduced. There is laryngitis.

A girl, aged 23. Her speech was very slow and often incomprehensible. She usually lay like a log, but in her sleep she moved and sometimes spoke intelligibly. The movements of the soft palate and vocal cords were normal.

A male, aged 22, has periods of "blindness" (due to ocular myoclonus) lasting for hours. His speech is slow, monotonous, mostly unintelligible, hesitating; takes a long time to produce his words, then he stops and after a long interval he speaks again. His gait is reminiscent of his speech, for he stops, hesitates, and walks again or even runs.

Female, aged 23, gradually became extremely emaciated and mute some months before her death.

The investigation of the speech disturbance in Parkinsonism by ear alone is insufficient for many reasons, and the descriptions of the speech vary. On the other hand, the graphic method of recording the speech defects is very valuable for diagnosis. The records can be accurately measured and analyzed, and if compared from time to time, show any change in the speech. The graphic method detects disturbances which remain undetected by the ear, and this appears to be the case also in early stages of progressive paralysis of the insane, disseminated sclerosis (especially with cortical lesions), etc. A variation of the graphic method may be of use in teaching deaf children.

The apparatus for speech records is based on the idea of Marey, adapted for speech by Rousselot, and

later much improved by Scripture. The patient speaks into a mouthpiece connected by a rubber tube with a recorder. As the patient speaks the vibrations pass down the tube and are recorded on a revolving smoked drum. Before or after recording the speech a time line is made showing 100 vibrations per second. The record is then fixed. Instead of the smoked paper I propose the substitution of an ink tracing.

The vowels and the consonants appear in the inscriptions as a series of fine waves. The length of each wave is measured in thousandths of a second under a special microscope. The results are plotted on cross-section paper. A line drawn through the series of dots gives the rise and fall of the voice, or the melody of the words spoken, i.e. "the melody plot." The melody plots of normal speech show that the voice is continually rising and falling, and that there are finer fluctuations of flexibility.

As examples, a short history and speech records are given of five patients with post-encephalitic paralysis agitans and the results of the laryngoscopic examination :—

*Case 1.*—Male, aged 20, does not remember any previous illness. About four years ago noticed that speech was becoming difficult and the mouth slightly open. On medical advice tonsils and adenoids were removed three years ago but no improvement resulted. Soon afterwards, patient noticed that his right hand trembled. On examination (with Dr. L. R. Yealland) Parkinsonism was diagnosed. Speech slow, low, monotonous; the soft palate showed strong movements and the actual vocal cord movements (abduction and adduction) were normal; laryngitis.

*Case 2.*—Female, aged 23. Does not remember any previous illness. Three and a half years ago noticed that her voice was becoming fainter. Two months later lost her voice for a time. She came to the West End Hospital for Nervous Diseases complaining of her voice and nerves. She often feels a "lump" in her throat. No signs of the Parkinsonism were present at first. Speech was investigated and found to be abnormal. ; Later, on examination (with Dr. L. R. Yealland) expressionless face, poor convergence, tremor of both hands and of the tongue were found. Stoops after sitting for a time. Right arm does not swing when she is walking. As a rule she draws in a low, colourless voice, but when she is angry she speaks hurriedly and her voice sounds more normal,

Saliva dribbles slightly when she speaks. Movements of the soft palate and vocal cords are normal.

These two cases are instances of post-encephalitic paralysis agitans, in which the first obvious symptoms were the abnormalities of the speech.

*Case 3.*—Male, aged 28. Eleven years ago had "influenza." Gradually the speech became slow; mouth was generally open and tremor developed. Tonsils and adenoids, to which slowness of speech and open mouth were attributed, were removed. I found signs of Parkinsonism with slow, hesitating and unintelligible speech. His condition has been more or less stationary for the last nine years. Soft palate does not move when speaking, but there were strong symmetrical movements when he was asked to say "ah." Tension of the vocal cords slightly reduced. Simple laryngitis.

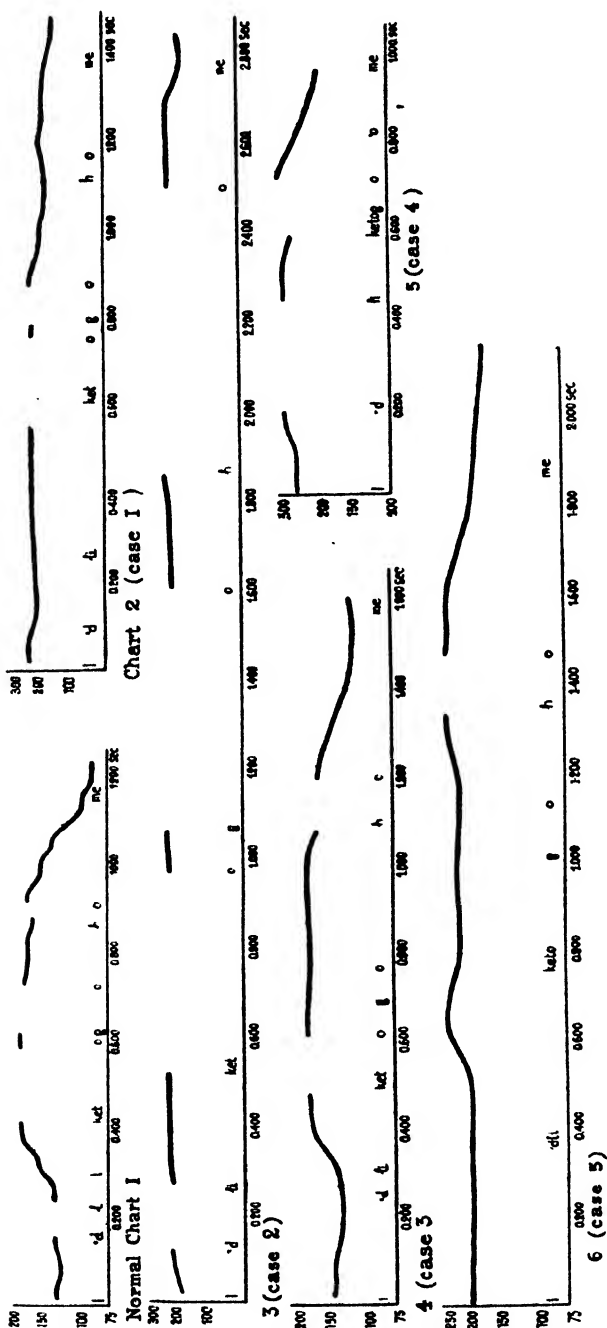
*Case 4.*—Boy, aged 13, had an acute form of epidemic encephalitis about seven years ago. Four years ago signs of Parkinsonism became apparent. Speech slow, monotonous. Movements of the vocal cords normal and those of the soft palate rather limited. Slight laryngitis.

*Case 5.*—Female, aged 21. Her speech was slow, monotonous and dull; she is usually incomprehensible. Speaking tires her. She can sit for days without trying to speak. Her soft palate moves slightly. The movements of her vocal cords are normal, and there is no laryngitis.

The laryngoscopic examination in advanced cases is very difficult as the patients cannot open the mouth wide and put out their tongue.

These charts show the melody with which the sentence "I'd like to go home" was spoken. The first chart is that spoken by a normal person. The others are spoken by persons with Parkinsonism. The inscriptions show how the sounds are greatly lengthened in this disease; the chart 5 (Case 4) appears shorter because the *H* was dropped. The waves are small owing to the high pitch of the voice. In the normal graph the melody is seen to rise and fall, but in these there is a marked lack of small fluctuations, and, except in the case of 3, there is also monotony.

Part of the *treatment* of Parkinsonism should be devoted to the speech, and should consist of voice and breathing exercises with such aids as the gramophone, etc. Occasionally the fitting of a mechanical appliance



Melody Chart of the sentence "I'd like to go home" spoken by a normal person (Chart 1) and by five patients with Parkinsonism (Charts 2—6).

in the mouth may be effective for a time.

#### CONCLUSIONS

(1) The speech in cases of Parkinsonism invariably shows some defects. It is generally slow, hesitating or jerking, unintelligible or incomprehensible; in late stages complete mutism may appear.

(2) The speech records show the extreme slowness, monotony and marked lack of small fluctuations, and are of assistance in diagnosis. By recording the speech at intervals the progress of the disease can be noted.

(3) During an actual examination the soft palate is found to be movable and it is seldom that, even in advanced cases, the movements are then limited. But in actual speech they become more limited.

(4) The majority of the patients breathe through the mouth, and in these cases laryngitis was found.

(5) The movements of the vocal cords (abduction and adduction) are generally slow but normal. In the severer forms, or when the patient is tired, they may diminish.

This interesting phenomenon is similar to the behaviour of the muscles of the extremities and face which, though usually rigid in such cases, may become quite flexible by a special effort, as after a word of command, etc.

(6) The speech defects are mostly due to rigidity of the muscles of the larynx, fauces, tongue, etc., though sometimes there is in addition dissociation of the speech function.

I am indebted to Mr. Lionel Colledge for the laryngoscopic examination and Professor E. Scripture and Miss F. Janvrin for the charts.

#### References.

Scripture : "Anwendung der graphischen Methode auf Sprache und Gesang," 1927. Leipzig. *Journ. Neur. and Psychopath.*, 1930, xi, 156.

Stolkind : *Proc. Roy. Soc. Med.*, 1923, xvi (Clinical Sect.).

*Idem* : *Lancet*, 1926, i, 391.

# Fat Children

By W. F. CHRISTIE, M.D.

MANY parents regard corpulence in their children as a portent of good health, or, at worst, a blemish which disappears with age. Left to "grow out" of their fatness, some children grow further into it. In after years they look back and say: "I was a chubby baby, a plump child, an adipose youth, and now, I am an obese old man before the age of 40. I fear that the trouble is incurable." A brief survey of the results obtained by treating the childish adiposities will show how seldom such a belief is justifiable.

Obesity may be due to dietetic error, to endocrine disorder, or to combinations of these. Gross pathological lesions affecting the glands of internal secretion are not considered in this article. It would seem that a few children are born fat, but that the majority acquire fatness afterwards.

## CONGENITAL OBESITY

Babies heavier at birth than ten pounds are uncommon. Amongst 3,600 children born at the Rotunda Hospital, Dublin, in only one case was the eleven pound mark exceeded. Most natal heavy-weights are post-mature babies, being large rather than adipose. No example of congenital obesity has come under my observation, but they exist. Endocrine disorders occur during intra-uterine life, and, since dietetic considerations do not apply, congenital obesity must be placed in the endogenous group. How else can Wulf's case be explained? "The child died at birth, weighing  $18\frac{1}{2}$  lbs. It was well proportioned, and looked as if it were three months old, except that it had an enormous development of fatty tissue." Some pre-natal error of metabolism must have occurred.

If such large children survive the ordeal of delivery, which rarely happens, they continue to increase in size out of all proportion to age. This was striking in the case reported by Percy and Laurent of the child weighing 13 lbs. at birth, 3 stone at 6 months, 10 stone at four years, and 32 stone at twenty years.

These, and a few similar cases on record, must be regarded as amongst the curiosities of medicine. No reports on the effect of treating them by glandular therapy are available.

#### ACQUIRED OBESITY

For descriptive purposes acquired corpulence may be considered as it occurs in (1) Infants, (2) Juveniles, (3) Adolescents.

(1) *Obesity in Infants.*—(a) The *dietetic* error may lie either in the quantity of the milk produced, or in its quality. With lacteal obesity, the fat is distributed evenly over the body. The cheeks are bulging, there

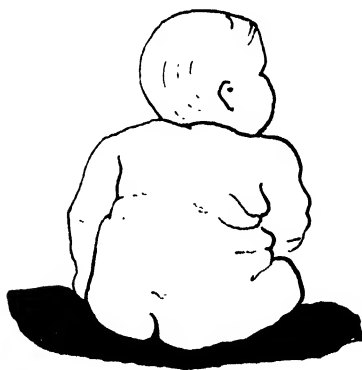


FIG. 1.  
Infantile adiposity (lacteal).

is a mild degree of double chin, rolls of fat are present on arms and legs, back, chest and belly. The skin is mottled, an unusual hardness of the subcutaneous tissue is quite appreciable to palpation, and the muscles feel flabby under their thick coating of fat. Some babies can adapt themselves to this abnormal state until wean-

ing brings them a happy release. In the majority, however, dangerous methods of getting rid of surplus food come into play, and the fat baby becomes a sick baby. Lacteal obesity is almost confined, nowadays, to prosperous families. The establishment of child-welfare clinics, by the teaching of dietetics to the poor, and the weekly weighing of their babes, has

helped to eliminate it from the lower walks of life.

(b) The *endocrine* type of infantile adiposity is hypothyroid in origin. Fat cretins are easily recognized; it is the slight degrees of thyroid insufficiency which are difficult. The distribution of fat is again general and uniform, as in obesity of lacteal origin. The history of the child, and one or two cretinoid features, will suggest the correct diagnosis. The mother will recall how it was a fine large baby at birth, but that it began to "go off" some months later, particularly when breast was replaced by bottle feeding. Backward in teething, late in sitting-creeping-walking, slow in talking, it is difficult to teach. The face does not light up with the bright smile of the normal child, in fact, it is rather stupid. One or more, but not all, of the following signs may be discerned: a subnormal temperature, a slow pulse, delayed closure of the fontanelle, sparse, dry, lustreless hair, waxy anæmic appearance, "button nose," thickish lips and tongue, dry cold skin, prominent belly, and constipation. These children respond well to thyroid feeding. For a six-months' child, 1/6th grain of dried thyroid extract, made into a powder with sugar of milk or glucose, should be administered once a day, at bedtime. The dose may be increased to  $\frac{1}{4}$  grain for a one-year old child. A close watch must be kept for untoward symptoms because, although thyroid may be borne well at first, the child's limit of tolerance to the drug may be reached quickly. It is wise to remember that dietetic errors—and they are not infrequent—must also be corrected. Neither dietetic nor endocrine obesity arising during infancy should be allowed to continue into the juvenile period.

(2) *Obesity in Juveniles.*—(a) *Alimentary.*—In all growing children, a close investigation of their habits will show that the amount of exercise taken and heat generated is less than the energy value of the diet consumed. Growth absorbs the extra food for building



purposes. Many children, however, eat more than they require; some are enormous and voracious feeders from an early age, while others delight in rich, fatty and starchy foods—at meal hours and in between. “Sugar and spice and all things that are nice,” often in the form of sweets of high calorie value, are added to normal meals. For “simple” fatness during the juvenile period, we must blame the parents. Many of these children lose weight at school, but gain it at home when dietetic control is relaxed.

Clinically, two types of alimentary obesity occur, the sthenic and the asthenic. In both, as in infantile obesity, the adiposity is general. In the mild *sthenic type*, which depends on an excessive but well-balanced diet, the complexion is florid, muscular system good, disposition cheerful, and the child is full of energy and go. In the *asthenic type*, which results from an excessive but ill-balanced dietary, the face is pallid, the blood mildly chlorotic, muscles—including the myocardial—are slack, and the child is listless and easily fatigued. Also, he is more prone to specific disease. Both types respond well to food regulation. Contrary to what one might expect, the obese child makes usually an enthusiastic dieter.

(b) *Glandular*.—The influence exerted on bodily growth by the secretion of each endocrine gland waxes and wanes according to the age of the child. It might, therefore, be expected that obesity due to glandular dysfunction would show a distinctive character at the different ages. Unfortunately, a defect in any one member of the endocrine group disturbs other members, hence few cases show classical monoglandular syndromes. Moreover, the majority of fat juveniles have also an exogenous basis for their fatness. Nevertheless, different types can usually be distinguished; for instance, the even temperament, sleepy

habits and large appetite of Pickwick's fat boy do not prevent us from diagnosing his case as a primary pituitary defect.

Not uncommonly school medical officers discover *thyrogenous* obesity in children between six and ten years of age. Generalized over-fatness is then associated with retarded development. Shortness of stature, delayed ossification of epiphyseal centres, and subnormality of talent give the clue. Other stigmata of thyroid insufficiency may be present, particularly common being the skin changes and constipation. The basal metabolic rate is rarely low enough to be diagnostic. Sometimes failure of dietetic treatment, and success when it is combined with thyroid feeding, is the only sure sign of thyrogenous defect. A half grain of the dried thyroid extract, in powder form, once daily, is usually sufficient to improve a child of six years.



FIG. 2.  
Thyrogenous  
obesity  
(short and fat).

Hypofunction of the posterior lobe of the *pituitary* gland occurs between the ages of six and fourteen years, and produces also a characteristic obesity. These cases show the typical pelvic girdle deposition extending from the level of the diaphragm to the middle of the thighs. Sometimes the shoulder girdle is affected also, but the neck and forearms, wrists and hands, lower legs and feet are always free. The skin is soft, smooth and velvety, and the face pudding-like. The intelligence is keen, but the temperament is lazy and placid. The extent of the deficiency will determine the clinical picture. Many cases are slight. In certain families each female member in turn becomes stout as the time of puberty approaches, but slims later when menstruation is established. Many fat, well-grown, bright boys become normal after full develop-

ment of the gonads. Their happy release from obesity is due to a natural correction of the endocrine balance.

In severer cases, the onset is earlier, and there may be a subnormal temperature, rudimentary

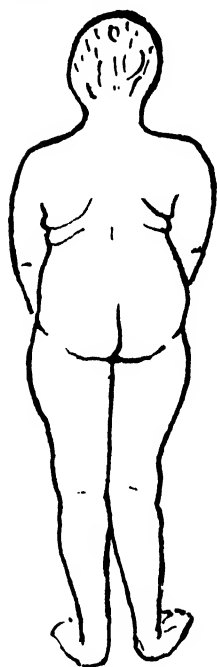


FIG. 3.  
Pituitary obesity.

lateral incisor teeth, absence of half-moons on the finger-nails, abnormal blood-sugar curve, or even X-ray changes in the pituitary fossa. Involvement of the anterior lobe of the gland adds striking features. Under-activity is characterized by small stature and late sexual development; over-activity causes large stature and early development of the genitalia. The handicap under which these children are forced to play the game of life, if they are left untreated, is three-fold—mental, sexual and physical. The cure consists of an artificial correction of the endocrine balance, combined often with a lessened dietary. Pituitary acts better when exhibited with thyroid in the

proportion of 2 to 1. Commence with small doses. The earlier diagnosis is made and treatment is instituted, the better the result obtained.

Obesity is sometimes, though rarely, associated with over-activity of the cortex of the adrenal gland. This type occurs in early childhood, i.e. between the third and the eighth year. Besides being fat, these children are overgrown, mentally dull, and show a peculiarly precocious sex development. No treatment is known to be effective.

(3) *Obesity in Adolescents.*—(a) *Exogenous.*—This type of corpulence arising during the final phase of childhood is most frequently female. Girls slow their rate of growth between the fifteenth and seventeenth

years; also they become more sedate. Instead of reducing food, they continue to eat as before. Adipose maidens are seen most often amongst strict adherents of the Jewish faith, whose food is oily and rich in calorie value.

(b) *Endogenous*.—Obesity of this type, when it arises at this age, is usually subthyroidic. Often the menstrual function is deranged. The hand and supraclavicular padding, so frequently relied upon for diagnosis in adults, may now be seen. The basal metabolic rate is slowed, though seldom as low as 15 per cent. below normal. The exhibition of thyroid orally and, to girls, ovarian extract intramuscularly, may tide them over what is often only a temporary glandular weakness. Sometimes atypical examples of pituitary fatness occur at this age. For instance, fat may be deposited in the buttocks and legs, leaving the face, arms and trunk slender. In my experience this local deposition resists most treatments, but is improved by rest. When glandular adiposity, commencing in the juvenile period, is continued into adolescence, several glands are usually involved. Pluriglandular obesity of several years' standing is difficult to improve.

#### CONCLUSIONS

The whole subject of obesity in children is obscure, but certain proved facts emerge. Fifty per cent. of fat children belong to the dietetic group which are completely curable. Whether or not they have inherited poorly functioning glands is immaterial to the result. Twenty-five per cent. constitute the thyroid deficiencies, which respond well to glandular therapy. In most instances thyroid feeding must be combined with dieting. Of the remainder, the prognosis needs to be guarded. Some pituitary obesities get better on their own, others improve with appropriate treatment.

# Enterospasm, Spastic Colon, or Tonic Hardening of the Colon

By T. STACEY WILSON, M.D., F.R.C.P.

*Consulting Physician to the Birmingham General Hospital.*

WITHIN the last few years attention has been drawn by many writers to an ailment of the colon in which abdominal pain, either dull and aching in character or of the nature of colic, is associated with muscular hardening of the intestine. These cases have been described under the term "spastic colon," a name which appears to be justified by the fact that the colon is felt to be muscularly hardened and that radiographs of such cases can be obtained which show considerable portions of the colon with its lumen reduced to zero.

Some of the best-known records of this condition are those by H. P. Hawkins<sup>1</sup>, J. A. Ryle<sup>2</sup>, E. L. Eggleston<sup>3</sup>, and the complete summary of recent literature by Robert Hutchison<sup>4</sup>.

In a recent article in *THE PRACTITIONER*, Bisset<sup>5</sup> has also drawn attention to this important subject, and has suggested the possibility that it may be to some extent allergic in character. If, however, hardness and tenderness of the colon be looked for as a matter of routine in all patients examined (as I have done for the last thirty-nine years) it will be found that the symptoms which are grouped under the term "spastic colon" constitute only a portion, and probably the least important portion, of the symptoms which may be associated with this abnormal condition of the muscular wall of the colon. Moreover, the routine palpation of the colon in all cases seen will show that

hardening and tenderness do not only occur under conditions which are explicable by the presence of contractile spasm—as when a radiograph shows some inches of the colon in which the lumen is reduced to zero—but that hardening and tenderness may also occur under conditions which cannot be thus explained. It is by no means unusual to find hard and tender portions of the colon with a definite lumen of an inch or an inch and a-half in diameter.

This type of hardening was discussed at the International Medical Congress held in Paris in 1900, and cases were then described in which portions of the colon were distended as well as being muscularly hardened. Mannaburg, of Vienna, spoke of parts of the colon being distended and as hard as a stone and forming a very tender tumour which the patient could feel. At the same meeting, Jules Geoffroy, in his paper upon “contracture” of the large intestine, spoke of the colon hardening under his hand and forming a tumour which could be grasped like a floating kidney. This last-named experience is one which I myself have often had. It is therefore evident that this ailment is a functional derangement of the colon of a more complex character and with a wider range of symptoms than that described under the term “spastic colon.”

My first introduction to this ailment was in 1892, when I was fortunate enough to have under my care a patient in whom the whole of the ascending colon and cæcum remained hardened and with a diameter of an inch and a-half, for several days, and in whom the hardening was unmistakably due to pure muscular activity. It was also fortunate that I was sufficiently alert mentally to recognize that the condition must be due to some as yet undescribed form of muscular activity. More than ten years elapsed, however, before Sir Charles Sherrington described “postural activity” of muscular fibres, and demonstrated the

existence of a "static" type of activity which was capable of making a muscular tube become rigid without obliteration of its lumen. That such a thing is possible is now well known, for it occasionally happens, during an abdominal operation, that a surgeon will see a few inches of a flaccid piece of intestine suddenly become cylindrical and rise up as an arch closely resembling a piece of rubber tubing of some  $\frac{1}{2}$  to  $\frac{3}{4}$  inch in diameter. Such a hardened piece of intestine will behave as if its walls were elastic—springing up again after being pressed down and becoming cylindrical again after being flattened. After a few seconds the hardening will pass off and the bowel once more become flaccid. In some cases hardenings such as this will recur during an operation in the same, or in different portions of the intestine.

It will, I believe, be recognized before long that this "static" hardening of intestinal muscles (which may be described as an "elastic fixation" of the protoplasm of some of their fibres) constitutes a normal type of intestinal muscular activity. Whether this be so or not, it is certain that a serious amount of resistance to normal contractile activity in the bowel—whether peristaltic or tonic—can be offered by an abnormal amount of this muscular hardening and that such resistance might well be a source of pain.

Here, then, we have a satisfactory explanation of the various types and degrees of pain which are known to occur in patients suffering from muscular hardening of the colon. The fact that hardening is usually accompanied by tenderness on pressure, and sometimes by very great tenderness, is in harmony with the belief that opposing types of muscular activity are associated when the colon is abnormally hardened.

The symptoms, the etiology, and the treatment of this ailment will be more readily understood if the following statements receive the acceptance which I believe they merit :—

(1) The muscular fibres of the intestine are normally liable to a form of "static" (i.e. non-contractile) activity in which their protoplasm becomes hardened and possesses a measure of elasticity.

(2) This static muscular activity is under nervous control and obeys the laws of reflex activity.

(3) One of the two chief stimuli which may originate this type of activity is the presence in the colon of the kind of vegetable fibre, cellulose, etc., which normally undergoes digestion there.

(4) In this, as in other forms of reflex activity, the amount of muscular response which can be originated by any definite amount of stimulus depends upon the excitability of the reflex nervous mechanism.

(5) An abnormal excess of this static hardening may offer such an amount of resistance to peristaltic or tonic contraction as to originate a condition of muscle strain in the colon wall.

(6) Muscle strain occurring in the colon may either :  
(a) originate a sensation of pain if the nervous impulses concerned pass from the sympathetic nerves into the sensory tracts of the spinal cord by way of the rami communicantes; or (b) originate some other type of nervous disturbance if the impulses concerned do not leave the sympathetic system but pass to the brain along the nerve paths which normally subserve the impulses which regulate the muscular activities of the colon.

(7) When an abnormally irritating impulse (such as we are speaking of) reaches the brain by a sympathetic nerve path one of the following effects may be produced : (a) there may be an intensification of some one or more of the general reflexes which afferent impulses from the digestive organs can originate (such, for example, as contraction of the systemic arterioles); (b) there may be an intensification of reflexes more directly concerned with the processes of digestion (such, for example, as abnormal closure of the pyloric



or ileo-cæcal sphincters, modification of the heart's activity, etc.); (c) the disturbing impulses may have a direct effect upon the brain and cause some abnormal mental state, more especially some form of mental depression. Under these circumstances, the mental misery ("mental pain") will be more or less proportional in degree to the abdominal pain which would have been experienced if the impulses concerned had entered the sensory tracts of the cord instead of passing to the brain along sympathetic nerve paths. (The correctness of this statement is suggested by the observation that patients occasionally are able to cut short an attack of mental "pain" by intentionally causing abdominal pain by pressure upon some tender part of the colon.)

These statements open the way for a brief discussion of some of the more important symptoms due to hardening of the colon.

#### PAIN

As most of the pain impulses enter the cord through the rami communicantes the pain must be of a referred or segmental character and felt in the skin area which is in relationship with the particular segment which receives the pain impulse. When, however, a part of the colon is sufficiently enlarged and tender to be palpable by the patient the pain may be accurately located in the part of the colon in which it arises.

The commonest situations in which the pain may be felt are as follows:—A small area in the right or left hypochondrium representing the ninth dorsal segment; an area to right or left of the umbilicus, representing the tenth segment; an area in the right or left iliac fossa, representing the eleventh segment; a small area in the region of the right or left sacro-iliac joint, representing the twelfth segment (more rarely, twelfth-segment pain is felt in the *anterior* area which lies just over the bladder). Occasionally pains may be felt

in the thighs over areas representing the lumbar segments of the cord, and very occasionally over the areas in the legs and feet which are in relationship with the sacral segments of the cord.

These referred pains are usually accompanied by a certain amount of tenderness of the subcutaneous nerves in the area where the pain is felt. This fact makes it easy to distinguish between a referred pain and a true visceral one. Take, for instance, pain in the gall-bladder region: All that is necessary for diagnosis is to make the patient contract the muscles of the abdominal wall (as when raising both feet from the bed) and the tenderness on pressure will be greatly intensified if the pain be a referred one, for the tender subcutaneous nerves will be pressed against the hardened muscular layer. If, on the other hand, the tenderness be due to the gall-bladder it cannot be elicited when the abdominal muscles are contracted.

An important diagnostic point in connection with pain of colon origin is its liability to occur at times when the colon is functionally active. Of these, the most characteristic is the period between midnight and 4 a.m., when the colon is presumably preparing for the morning evacuation of the bowels. When a patient is awakened with pain in the small hours of the morning it is almost certain to be of colon origin and to be easily curable. Colon pain is also liable to occur after meals and, if the transverse colon be involved, the muscular activity in the colon which would be set up by the vibration of a vehicle or by walking may originate colon pain.

#### MENTAL SYMPTOMS DUE TO HARDENING OF THE COLON

It is of great importance that the practitioner should recognize that a very considerable portion of the cases with abnormal mentality which come under his care, are due to this ailment of which we are speaking, and that when colon hardening gives rise to mental

symptoms, no abdominal symptoms of any kind may be present. The diagnosis rests simply on the fact that the colon can be felt to be tender and harder than normally, more especially in the right or the left iliac fossa, or both. Occasionally a case with severe mental disturbance is met with in which the abdominal colon is normal on palpation but the rectum is found to be very hard and tender.

Other points of great diagnostic value are that the mental symptoms are liable to be severe between midnight and 4 a.m., on first waking in the morning, after meals, or as the result of mechanical vibration. Sometimes a patient will be unable to travel in a vehicle over a rough road because of the uncontrollable fear which is originated by the jolting.

The most common type of mental disturbance is depression, which may vary in degree (according to the severity of the case) from simple unhappiness up to severe suicidal melancholia. A more general recognition of this fact in the past would probably have prevented many a case of nocturnal suicide. Some form of morbid anxiety is also very common, and its degree may vary from simply a tendency to over-anxiety or worry up to very definite phobias or obsessions. Various types of suspicion are also very common. In children deficient power of application, inattention, and the lack of mental balance which characterizes "the difficult child" may be due to this ailment and be readily curable in a few weeks by simple treatment. In such cases also there may be few or no abdominal symptoms.

#### NEURASTHENIA IN RELATION TO COLON HARDENING

The abnormal mentality due to this ailment is a frequent cause of neurasthenia, especially in young women. They are ashamed of the obsessions or phobias from which they may be suffering and they endeavour to keep a smiling face in spite of attacks

of mental depression. The result is that they exhaust their powers of self-control and a condition of neurasthenia results. In such a case the discovery of tenderness and hardness of the colon gives a clue to the cause of their trouble, and sympathetic enquiry may induce them to reveal something as to the nature of their mental suffering. Sometimes these cases rapidly respond to treatment of the colon ailment, but if the neurasthenia be pronounced the over-excitability of the nervous system militates against the cessation of the abnormal muscular activity in the colon, and definite treatment for the neurasthenia will have to be combined with the treatment of the colon.

#### TREATMENT

The treatment of these patients with hard and tender colons is a very simple matter if the ailment be recognized in its early stages. All that is necessary is to give a mixture containing tincture of hyoscyamus in 20-minim doses, with 10 grains of salol made up with mucilage and chloroform water, three times daily, after meals, together with a diet from which salads, green vegetables, all uncooked fruit pulp and "roughage" in general is eliminated. One caution must, however, be given, namely, that some patients (owing, presumably, to faulty alkalinity of the duodenum) are not able to break up the salol into its constituent parts. Where, therefore, this mixture fails to relieve a patient, the giving of salol in tablet form may show, by the reappearance of the tablets in the stools, that the drug is not being dissolved. In such a case some other antiseptic must be chosen or the free administration of alkalis may rectify the intestinal defect.

The relief given in cases of abnormal mentality by this simple mixture containing hyoscyamus and salol is sometimes very striking in its suddenness and completeness. In July, 1929, I saw a working man's wife who for half a year had been suffering from severe

mental depression with frequent attacks of uncontrollable weeping by day or in the small hours of the morning; but after only three or four weeks of treatment with this mixture and dietetic precautions, and with only two interviews, she became normally happy and peaceful, and remained so.

In some severe mental cases a mixture containing 15 minims of perchloride of mercury solution, 15 minims of perchloride of iron tincture, 20 minims of tincture of hyoscyamus, made up with some glycerine and chloroform water, is very effective if given on an empty stomach 15 minutes before meal times. In cases, however, in which the stomach does not empty itself properly between meals, this remedy is valueless, because the mercurial salt is changed to an albuminate by the food in the stomach, and its power as an intestinal antiseptic is lost.

In dealing with cases of this ailment the great importance of maintaining the tone of the nervous system must never be forgotten.

It is not possible within the compass of a short article to deal adequately with this ailment, more especially in so far as its complicated relationships to other maladies are concerned. I would therefore refer those who desire a further account of it to my book on the subject.<sup>6</sup>

#### BY WHAT NAME SHOULD THIS AILMENT BE KNOWN?

The term "Enterospasm" or "Spastic colon" would be satisfactory if the meaning of the word "spasm" were extended so as to embrace "static" muscular activity. It is doubtful, however, whether this term would be acceptable for the static rigidity (i.e. "plastic tone") with which we are familiar in Parkinsonism. In my first paper on the subject I spoke of it incorrectly as "Colon catarrh."<sup>7</sup> In the account of it which I gave at the annual meeting of the British Medical Association in 1911, I spoke of it

as "Colon dyspepsia." This term, however, cannot be satisfactorily applied to the large number of cases in which all the symptoms are mental, and there is no evidence of indigestion. In my book on the subject<sup>6</sup> the term "Tonic hardening of the colon" was used, and possibly some such term as "Muscular hardening of the colon" might prove acceptable. It is, however, to be hoped that some new and better name will be found for this important ailment, for it is the cause of much suffering, both physical and mental, which might very easily be prevented by appropriate treatment.

#### References.

- <sup>1</sup> Hawkins, H. P. : *Brit. Med. Journ.*, 1906, i, 65.
- <sup>2</sup> Ryle, J. A. : *Lancet*, 1928, ii, 1115.
- <sup>3</sup> Eggleston, E. L. : *Journ. Amer. Med. Assoc.*, 1928, xci., 2049.
- <sup>4</sup> Hutchison, R. : *Medical Annual*, 1930, 125.
- <sup>5</sup> Bisset, A. A. : *THE PRACTITIONER*, 1930, cxxv, 749.
- <sup>6</sup> Wilson, T. S. : "Tonic Hardening of the Colon." London : Oxford Medical Publications.
- <sup>7</sup> *Idem.* : *Brit. Med. Journ.*, 1902, ii, 1759.

# Some Clinical Observations on Cancer

By W. B. COSENS, M.R.C.S., L.R.C.P.

*Late Honorary Consulting Surgeon to the Dorset County Hospital.*

I AM no expert on cancer research, just an observer in general practice for over forty years, but two special clinical facts have come under my observation: first, that an increased pulse-rate occurring with a cancerous growth, no matter the locality or size of the growth, is a symptom denoting a bad prognosis; secondly, a tender colon. The following record of two cases explains my points:—

By a strange coincidence, ten years ago, I saw in the same week two women, one aged 36 and the other 35. They both had growths in the upper and inner segment of the left breast; in both cases the growth did not exceed the size of a small tangerine orange. The elder woman had a pulse-rate of 86, the younger 72; the rate never varied in either. They both had tender pelvic colons. I did the complete operation in both cases. Friends naturally asked my opinion as to the future. In the case of the one with the pulse-rate of 86 I gave a very guarded prognosis. She died at the end of nine months with secondary deposits in her abdomen. The other case is alive and well to-day.

The second clinical fact I have noticed is that 85 per cent. of cancer cases have a slightly tender left pelvic colon. If I had the opportunity and the necessary skill, I should like to examine in the pathological laboratory, every colon of a person who had died from any form of cancer. The colon is the neglected cesspool of most individuals. Its contents eventually find their way on to the land or into the sea. Is there not a possibility that this method forms the carrier by which our food, animal world, fish, and ourselves become infected?

Some day the large intestine will receive as much

attention as the mouth. Uncleanly teeth or infected tonsils support a whole army of bacteria and organisms that are antagonistic to health, and there was at one time almost a craze to remove all teeth and both tonsils. My experience has been that sarcoma in children under ten years of age is most frequent in the jaw, in immediate connection with the lymphatics of the mouth. Everyone knows that the bottle-fed baby quickly reacts against decomposing food stuffs, the stomata in the mouth become inflamed and there is general constitutional disturbance.

Is it not within reason to suggest that food may contain an unknown and latent virus which finds a suitable developing ground in the vast alimentary tract of man and beast, and that the most easy area for absorption is in the mouth and large intestine? We know that the majority of human beings may be "carriers" of any virus, the disease clinically developing in the few.

The importance of mouth hygiene is recognized by all. I suggest that the importance of colon hygiene is overlooked. Aperients are useless for this purpose. Two pints of water when injected, are rapidly absorbed by the rectum and pelvic colon; the small intestine, with the exception of the duodenum, refuses to absorb all of its food contents, the colon seems capable of absorbing anything.

I have found in practice, in many cases of obscure ill-health, that if the colon is washed out on alternate days with two or three pints of iodine solution,  $\frac{3i}{1}$  to the pint, much of it is readily absorbed and eventually finds its way into the urinary bladder, thus ensuring the cleansing of the lymphatics of the intestine; the improved condition of the patient becomes obvious within two or three weeks, as evidenced in colour by a greater increase in hæmoglobin, and a feeling of greater well-being. This may be called Plombières treatment; I prefer the name



washing-out. It can be done by the patient himself and requires no special armamentarium other than a douche-can and a few feet of rubber tubing.

We should treat the colon with the same care that we do our teeth. Mouth and colon in effect represent the two ends of our alimentary tract, they are the recipients of crude material food. The middle portion being selective takes care of itself. The small intestine sorts out what is necessary for life. The debris is collected in the large intestine where, if it is not soon evacuated, it undergoes rapid decomposition and lymphatic absorption. By habit we are inclined to give greater attention to the seen than we do to the unseen. Another common example of this dictum is in the comparative care of our hands and feet.

There is nothing original in all this, I am simply voicing the idea that owing to modern conditions due to excess of population, there is an unknown pollution of food stuffs, as there used to be of water, or in their preparation, instanced in the case of rice and beri-beri. The disease of cancer was known over two thousand years ago; the cause must have been the same then as now. What more likely than that the poison was conveyed by food and water? I suggest that it is by way of the large intestine that the cancer virus is absorbed, and that by a simple method of treatment the lymphatic absorption of the virus may be controlled.

Within another century all human and animal dead bodies will, I hope and believe, be cremated; application of manure to the land will be regulated, as a means of preventing infection to our water and food supplies.

# Practical Notes

## *Laryngeal and Intestinal Tuberculosis.*

Rubin reports that at the Montefiori Hospital, New York, approximately half the patients with pulmonary tuberculosis have laryngeal tuberculosis and two-thirds intestinal tuberculosis. The incidence of laryngeal tuberculosis was equal in the two sexes, contrary to the general belief that it is two or three times commoner in males than in females. Laryngeal and intestinal tuberculosis co-exist in 39 per cent. of fatal chronic pulmonary tuberculosis; among 230 patients with laryngeal tuberculosis, intestinal ulceration was found in approximately 90 per cent. at all ages, and 95 per cent. in those patients under 30 years of age. Among 296 patients without laryngeal infection the intestines were affected in 47 per cent., and in patients with intestinal tuberculosis the larynx is attacked in 59 per cent., whereas, when the intestines are healthy, the larynx is affected in 14 per cent. Laryngeal tuberculosis is therefore four times as frequent in patients with tuberculous disease of the intestines as compared with those whose intestines are healthy. It is thought probable that the frequent association of laryngeal tuberculosis is not a mere coincidence but that, when the conditions of the body are favourable, organs of greater susceptibility are more apt to be affected. (*American Journal of Medical Sciences*, 1931, May, clxxxi, 663.)

## *Tubercle Bacilli demonstrated by Gastric Lavage in Children.*

In children who as a rule swallow their sputum the diagnosis of pulmonary tuberculosis may be greatly assisted by microscopical examination of material obtained by gastric lavage, its cultivation on Petroff's medium and inoculation into guinea-pigs. Valdemar Poulson of Copenhagen, who advocates this procedure in otherwise obscure cases, reports five cases illustrating the value of the method and gives figures of its employment; in 48 cases, in children older than 3 years, tubercle bacilli were thus found in 12, and in 8 of these clinched the diagnosis. One examination of material obtained by gastric lavage is not sufficient; among 53 positive cases tubercle bacilli were found on the first examination in 38, on the second occasion in 12, on the third in two, and on the fourth in one. Expense can be diminished by performing gastric lavage on two successive mornings and mixing them before testing the whole amount.—(*American Journal of Diseases of Children*, 1931, April, xli, 783.)

Arvid Wallgren of Göteborg, Sweden, employs this method, first described by Meunier in 1898, to decide if children with erythema nodosum, a positive tuberculin test and hilum shadows are excreting tubercle bacilli. During the past year he examined 40 children with erythema nodosum; 37 of these gave a positive tuberculin reaction, and of these, 17 showed tubercle bacilli.—(*Ibid.*, 1931, xli, 816.)

*Bacillus Coli Infections of the Genital Tract.*

L. Strominger, of Bucarest, reviews and reports cases of *Bacillus coli* infections of the prostate, urethra, epididymis, and uterus. The infection of the prostate may be the direct sequel of intestinal disorder or may be implanted on gonococcal infection, and may give rise to abscess formation. Such prostatic infection may, it is suggested, be responsible for vesical disorder in the patients' wives. Urethritis in like manner may be due to *Bacillus coli* infection as an original infection or subsequent to gonorrhœa, and the obstinate character of some gonococcal urethral cases may be due to such a combined infection. Epididymitis due to *Bacillus coli* infection is generally acute, with high fever and vesical symptoms; but sometimes it is so slow as to suggest tuberculosis; abscess formation may occur in this localization, which has been met with in babies. In women vaginal, uterine, and annexal infections with *Bacillus coli* are probably much more frequent than is generally recognized, because not often looked for bacteriologically; a vigorous reaction, improvement, and sometimes cure of the pelvic conditions in women, including hæmatoceles, after submucous or intramucous injections of a *Bacillus coli* vaccine is regarded as evidence in favour of this origin.—(*Presse médicale*, Paris, 1931, June 6, 835.)

*The Problem of Infection in the Treatment of Prostatic Obstruction.*

Hugh Cabot points out that when prostatectomy was introduced 35 years ago, the mortality was mainly due to renal insufficiency. This led to the enunciation of the principles of drainage and the development of various methods of studying kidney function, which resulted in a reasonably accurate estimate of renal capacity. In the period 1900 to 1915 these developments began to bear fruit and the mortality fell rapidly, chiefly perhaps, as the result of drainage, either urethral or suprapubic, but to a considerable degree from improvements in technique; even then renal insufficiency accounted for more than 30 per cent. of the fatalities, and hæmorrhage for 20 per cent. In the last fifteen years as the result of further improvements in technique renal insufficiency, presenting the picture of nausea, vomiting, distension has fallen from first to at least the fourth place. At the present time the causes of death are in order of importance: infection, including pyelonephritis, infection of the prevesical space, epididymitis and periurethritis; in the second place various forms of pneumonia; and then vascular lesions, pulmonary embolism and cerebral hæmorrhage. The attention paid to renal function has distracted attention from the prevention of infection. The infections with *Bacillus coli* rarely cause death, whereas those with *Proteus ammoniæ* are highly lethal. Catheter drainage is extremely prone to be followed by infection of the whole urinary tract, and unless this can be prevented by some discovery the position of one-stage prostatectomy is in jeopardy. Epididymitis, perhaps a more serious complication than has generally been recognized, can be avoided by division of the vas deferens at

the time that drainage is started.—(*Proceedings of the Staff Meetings of the Mayo Clinic*, March 18, 1931, vi, 163.)

### *Compression Fracture of the Spine.*

S. W. Boorstein reports 49 cases of compression fracture of the spine, and sums up his conclusions as follows: Every case of injury to the spine should be examined with extreme care to rule out fracture. Immediate rest should be instituted until the examinations are complete. If it does not endanger the patient, the roentgenogram should be made immediately; otherwise a delay of twenty-four hours to forty-eight hours may be deemed advisable. Radiographs should be taken in two views, anteroposterior and lateral. If doubt remains, stereoscope films should be taken as well. If the roentgenogram is negative but the symptoms point to a fracture, another roentgenogram should be made in a few days, as it may then show the lesion. Diagnosis rests on history, localized pain and stiffness of the spine. Fractures of the laminae, transverse and spinous processes, articular processes, the ribs, the bones of the extremities, especially the os calcis, are frequently present, complicate the prognosis and influence treatment. Treatment: Rest on Bradford frame, then plaster jacket or two plaster shells.

The conservative treatment is attended by excellent results. Full functional return may be expected after four to six months of recumbency and hyper-extension with the spine immobilized in a shell or jacket. Early operation is indicated where the X-ray shows dislocated bone pressing upon the spinal canal. Patients with fresh fractures should rarely be subjected to operative interference. In cases of a complete transverse lesion of cord, operative interference can do no good. In cases of incomplete lesion where there are indications for operation, it is more beneficial to wait two or three weeks. Later nerve operations are indicated in cases of progressive symptoms and where adhesions are present. All patients having injury in the cauda equina should be operated on, since the nerves of the cauda equina are capable of regeneration. In late cases where pain still exists, nature has not ankylosed the injured region of the spine, and the patient is to return to strenuous back-bending labour, ankylosing operations should be considered. They are likely to save time and allow the patient to labour without apprehension.—(*American Journal of Surgery*, April, 1931, xii, 1, 43.)

### *The Treatment of Fractures of the Axis.*

G. Lucchese reports two cases of fractures of the axis vertebra, without symptoms involving the nervous system, in both of which cure was brought about through immobilization by means of plaster. The author points out that cases of fracture of the axis are not so rare as might be imagined, and although fractures of the upper cervical region of the spine have a bad prognosis, the prognosis is not necessarily so bad as is usually supposed, provided that appropriate treatment is carried out promptly. In one of the cases reported there was a fracture of the vertebral pedicles with dislocation forwards of the body of the axis, and in the other

case the odontoid process of the axis was fractured at its base with dislocation backwards of the odontoid process.—(*Chirurgia degli Organi di Movimento*, January, 1931, xv, 481.)

C. Angelesco and G. Buzoianu report a case of fracture of the axis without medullary symptoms, the fracture affecting the body and the base of the odontoid process. The authors point out that a fracture of the anterior arch of the axis is incomparably more serious than a fracture of the posterior arch, so long as the fracture is not accompanied by an occipito-atlas or atlo-axis dislocation. Treatment demands immediate and rigorous immobilization by means of plaster, and decompression is not indicated unless the fracture is accompanied by medullary symptoms of severe compression.—(*Revue d'orthopédie*, May, 1931, xviii, 201.)

### *Syphilitic Mesoarthritis and its Treatment.*

F. Kisch contributes valuable clinical observations on 483 cases of luetic arthritis. The time of onset of mesoarthritis after the initial infection was considerably and rather surprisingly different in those who received treatment early and in those who did not. In those who had received no treatment during the primary stage, clinical symptoms of arthritis did not develop until 23 years after infection; in those who received insufficient treatment, 27 years elapsed; whilst in those treated during the primary stage with salvarsan arthritis developed after an interval of 14 years. In uncomplicated cases of mesoarthritis in which there is no aortic insufficiency or myocardial degeneration, a preliminary course of treatment with sodium iodide should be followed by treatment with salvarsan in small doses, preferably in conjunction with a digitalis preparation. Complicated aortic syphilis is not suitable for treatment by salvarsan. In these cases, it is safe to give digitalis and salyrgan, and later, digitalis with sodium iodide. The damaged myocardium is by this means often enabled to regain some degree of efficiency. Statistically Kisch found that by this method of treatment the time interval between the onset of cardiac insufficiency and death was lengthened more than by any other method.—(*Klinische Wochenschrift*, June 13, 1931, 1117.)

### *The Treatment of Peptic Ulcer.*

E. D. Ahern discusses anatomical conditions and physiological disturbances bearing on the subject of peptic ulcer. He emphasizes the part played by associated abdominal conditions in the etiology of peptic ulcer, and particularly right-sided ptosis. The relationship to ptosis of disturbance of the sympathetic nervous system is discussed, but no definite conclusions are arrived at. The possibility of infection by the lymph stream from the terminal portion of the ileum, the appendix and the cæcum is also examined by the author in the light of recent work, and the theory that this is a probable cause of the condition is upheld by him. As regards treatment, the author lays most emphasis on the importance of a search for septic foci, and on the value of a properly performed gastro-enterostomy.—(*Australian and New Zealand Journal of Surgery*, June, 1931, i, 52.)

# Reviews of Books

*Abdominal Pain.* By JOHN MORLEY, Ch.M., F.R.C.S. With an Introduction by J. S. B. STOPFORD, M.D., F.R.S. Edinburgh : E. and S. Livingstone, 1931. Pp. xv and 191. Figs. 22. Price 10s. 6d.

THIS is a book which everyone who wishes to gain a more accurate knowledge of the diagnostic significance of abdominal pain will do well not only to read, but to digest in a manner worthy of the way in which it is here presented. It is appropriate and significant of the times that a surgeon of Manchester should continue the researches, published in 1888 by James Ross, physician to the same hospital. This monograph, admirably introduced by the Professor of Anatomy in the University of Manchester, is the outcome of careful examination of the painful manifestations which are then correlated with the morbid conditions found at a subsequent laparotomy. Confining his attention to organic disease, Mr. Morley has ingeniously obtained experimental evidence of value by the use of regional anæsthesia in human subjects ; thus, infiltration with novocain of the painful cutaneous area in acute appendicitis and obstructive cholecystitis completely abolished the painful manifestations. The growth of knowledge of abdominal pain built up by Lennander, James Ross, Mackenzie, Head, Hurst, and Kappis, is critically presented ; the explanation of a viscerosensory reflex put forward by James Mackenzie is shown to be unsatisfactory and good evidence is brought forward for the substitution of the author's theory of peritoneo-cutaneous radiation. Irritation of the parietal peritoneum, and not of the viscera, is the starting point ; deep and superficial tenderness and muscular rigidity of the abdominal wall, so commonly seen in inflammatory conditions in the abdomen, are not in any way concerned with the afferent autonomic system, but are entirely referred from the highly sensitive cerebro-spinal nerves of the parietal peritoneum ; the mechanisms of peritoneo-cutaneous and peritoneo-muscular radiation are closely allied, and are put before the reader as a simpler and more satisfactory explanation of referred somatic pain than Mackenzie's theory of viscerosensory and visceromotor reflex.

*The Diagnosis and Treatment of Brain Tumours.* By ERNEST SACHS, A.B., M.D. London : Henry Kimpton, 1931. Pp. 396. Figs. 224. Price 42s.

THE subject of this book is dealt with in a systematic manner for students, anatomy and physiology, methods of examination, pathology, symptoms, and diagnosis all receiving attention, while the ninth and last chapter is devoted to operative treatment. The author shows a natural and justifiable bias in favour of the work of his countrymen in this branch of surgery, but throughout he recognizes that of Europe in the field of neurology. There is little to arouse comment in the section devoted to anatomy and

physiology, though the cerebro-spinal fluid receives scant reference, and the chapter on neurological examination is short. Many radiograms are here reproduced, but he does not make very much of their diagnostic importance. Here also there are sound cautions regarding the discomforts of the Barany tests and the dangers of ventriculography. Surgical pathology is based on the embryological conceptions of Cushing and Bailey, but his estimate that 45 per cent. of brain tumours are "meningiomas" is optimistic, as these tumours, favourable as they are to surgical prospects, amount in this country to about one-fourth of such a proportion. His operative methods are those of Cushing, and local analgesia is recommended, with light ether as second choice. We cannot agree with his commendation of the combination of an osteoplastic supratentorial occipital flap with posterior fossa craniectomy, as where both aspects of the tentorium are to be explored, the large posterior osteoplastic flap of Souttar has in this country replaced other procedures. The operative section, like the rest of the book, is profusely illustrated and reveals once more the ingenuous delight of the American surgeon in the contemplation of his well-healed wounds.

*Treatment of Epilepsy.* By FRITZ B. TALBOT, M.D., Clinical Professor of Pediatrics, Harvard University Medical School. London: Cassell and Co., 1931. Pp. xii and 308. Figs. 11. Price 18s.

As epilepsy usually begins before the age of 20, and as it is important to correct and obviate this evil habit before irreparable damage has been done, it is obvious that more stress should be laid on early treatment and it is appropriate that this volume should be written by a well-known authority on the diseases of children. The possible causes of epilepsy, such as endocrine disorders, anaphylaxis and trauma, and the question of the morbid anatomy, such as dilatation of the subarachnoid spaces are reviewed in a very critical manner; later it is stated that in no two cases is the cause of the seizures the same, and that as yet there is not any form of treatment which cures all cases. Prophylaxis is therefore difficult, though the hereditary character naturally raises the question of eugenic measures. In the section on the treatment of the actual seizure it is pointed out that the immediate sleep is beneficial and that if interrupted too soon, headache and other discomforts may result. All the dietetic forms of treatment, except that of protein restriction, cause dehydration, though by different mechanisms. Generally speaking epileptics eat too much, but fasting as a method of treatment is seldom employed now because, though it may have a temporary effect, this is not permanent; cases are quoted showing freedom from fits during the period of fasting only, and are contrasted with the permanent freedom that may follow the ketosis produced by a high-fat, low-carbohydrate diet. The ketogenic dietary is exhaustively described and useful tables are provided; the epileptic patient on a ketogenic diet should be educated so as to be able to look after his food both in quality and quantity. The swing of the pendulum as regards the significance

of ketosis is rather remarkable. Some 15 years ago a serious complication was suspected if acetone bodies appeared in the urine of children acutely ill; now there is some evidence that it is a protection, thus an individual with dietary ketosis usually escapes a common cold while the other members of a family succumb. Prolonged ketosis does not affect growth and development in any way so long as the ultimate needs of the body are satisfied. The ketogenic diet, which has also been given in migraine, is more successful in children than in adult epileptics.

*The Practical Treatment of Diabetes.* By T. IZOD BENNETT, M.D., F.R.C.P. London: Constable and Co., 1931. Pp. ix and 107. Figs. 4. Price 6s.

THIS is a clear and readable account of the modern treatment of diabetes mellitus. In the first chapter, on the diagnosis, stress is laid on the fact that a well-marked increase in glycosuria after a carbohydrate meal is an almost certain proof that true diabetes is present, for renal glycosurics do not show this increase. Students and practitioners, he adds, too often believe that there is a form of benign glycosuria termed alimentary. After setting out the general principles of treatment, including the necessity for education and collaboration of the patient, he enters fully into the details and describes the methods, indications for, advantages and disadvantages of insulin treatment. The complications of diabetes receive due attention, and in the appendix Dr. R. D. Lawrence's useful food tables are by his permission reproduced.

*Psychology of Early Childhood, up to the Sixth Year of Age.* By WILLIAM STERN, supplemented by extracts from the unpublished diaries of Clara Stern. Translated by Anna Barwell. London: George Allen and Unwin, Ltd., 1930. Pp. 612. Plates 10. Price 18s.

THIS is the English translation of the sixth edition (1928) of the German work which first came out in 1914. The science of childhood is one of the most recent branches of human knowledge, and this rather bulky volume deals with the normal psychical development before the school age. Youth is divided into three periods, the first seven years before school life begins, the second seven years devoted to general education and terminated by puberty, and the remaining seven years of vocational training. The real scientific foundation of modern child-psychology was provided, in 1882, by Wilhelm Preyer's "Soul of the Child," in which the systematic observations on his son were recorded from the hour of birth to the end of his third year. Similar observations, but extended beyond the sixth year, have been carried out by the author and his wife, and by Soupin and his wife. In addition to the main lines of child psychology the Montessori and psycho-analytical methods are here fully considered. The psychological reactions of the infant and child at various ages, at birth and after, before the acquisition of speech, and in special directions are described in elaborate detail.



*The Physical and Radiological Examination.* By JAMES CROCKET, M.D., F.R.C.P.E. 2nd Ed. London: H. K. Lewis and Co., 1931. Pp. x and 296. Plates 40. Illustrations 111. Price 16s.

THIS handbook by the lecturer on tuberculosis in the University of Glasgow includes a chapter on laryngeal tuberculosis, which is so closely associated with pulmonary infection that its omission would have been a mistake. Written with special reference to tuberculosis and silicosis, this edition has been largely rewritten and fresh chapters added. The account of bronchography and the value of lipiodol (or iodipin) in the diagnosis of bronchiectasis, tuberculosis and other diseases of the lungs is illustrated by 16 radiograms. In the description of silicosis, asbestosis is included, as asbestos is a magnesium silicate containing about 40 per cent. of free silica; it is pointed out that not only does silicosis favour the development of tuberculosis by disorganizing the lymphatic flow in the lung and because the necrosis caused by colloidal compounds of silica facilitates the conditions for multiplication of tubercle bacilli, but that tuberculous infection accentuates the production of silicosis. Other interesting points are mentioned, namely, that tuberculosis implanted on silicosis is relatively non-toxic, less infective than ordinary pulmonary tuberculosis to others, and that whereas in the first and second stages of silicosis, acute tuberculous pneumonia, broncho-pneumonia and the miliary form are common, these are rare in advanced silicosis. There is an instructive illustration of congenital absence of the pectoralis major muscle simulating the flattening of the chest due to chronic pulmonary tuberculosis; mensuration, vital capacity and breath-holding tests are considered in a special chapter, and for auscultatory percussion O'Kelly's stethoscope with a forehead rest, so as to leave the examiner's hands free, of which a figure is given, is recommended. Altogether there is much to be learnt from this well-written work.

*Recent Advances in Pulmonary Tuberculosis.* By L. S. T. BURRELL, M.A., M.D., F.R.C.P. 2nd Ed. London: J. and A. Churchill, 1931. Pp. ix and 240. Plates 32. Text-figures 17. Price 12s. 6d.

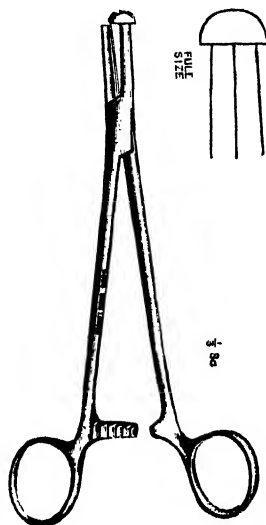
As was anticipated when it came out in 1929, a second edition would not be long delayed, and though not more than some twenty pages larger, a good deal of new material has been added. This is especially the case with regard to surgical treatment, and here full recognition is given to Mr. Morriston Davies' work on thoracoplasty and phrenic evulsion. Extrapleural pneumolysis, in which part of the lung can be collapsed by stripping the parietal pleura from the chest wall and filling the space thus produced by solid paraffin wax, fat or muscle, is also described for cases in which, owing to adhesions, it is impossible to induce an artificial pneumothorax. When a patient is too ill for thoracoplasty, multiple intercostal neurectomy on one side may be beneficial, though it is not a substitute. Other additions are oleothorax, poisonous gases as causing or aggravating pulmonary tuberculosis, the question of terminating at an early stage pregnancy in the tuberculous in view of the frequency of exacerbations after parturition, and the recent Lübeck disaster in connection with immunization of the new-born with B.C.G.

# Preparations and Inventions

## PHRENIC EVULSION FORCEPS

(London : Messrs. Down Bros., Ltd., 21-23, St. Thomas's Street, S.E.1.)

Mr. Walter Mercer, F.R.C.S.E., writes :—In performing the operation of phrenic evulsion the phrenic nerve is exposed in the neck under a local anæsthetic and grasped by fairly strong forceps. The nerve is then divided above the forceps and pulled slowly out from the chest cavity. The evulsion has to be very slowly proceeded with so that the nerve will be removed in as great a length as possible. If it is pulled out too strongly or too quickly the nerve may break. If this breakage occurs above the communicating branches which reach it below the clavicle, the diaphragm will still receive nerve impulses from these branches, so that the operation will be useless. By experience one finds that the best way of controlling this gradual pull on the nerve is to rotate the forceps and wind the nerve on to them very slowly. If ordinary forceps are used, the nerve slips off the end, since the forceps cannot be kept on the same plane as the nerve which lies at the bottom of the fairly deep wound. To overcome this minor difficulty, these forceps were produced. The round tip projects from the edges of the blade and so prevents the nerve from slipping over it. The blades themselves have longitudinal grooves, assuring a good grip of the nerve. The forceps should be of a fairly heavy type as this ensures a firmer and more complete control of the amount of force required.



## HEUDEBERT'S BREADS AND CEREALS

(London : Messrs. Morel Bros., Cobbett & Son, Ltd., 22 and 24, Buckingham Palace Road, S.W.1.)

Messrs. Morel Bros., Cobbett & Son announce that they have obtained an agency for the Heudebert breads and cereals, which are well known to most visitors to continental spas. These products are prepared in factories at Nanterre, Lyons and Brussels, and include dietetic breads (such as "essential bread," a bread without crumb prepared with soluble proteins as a basis, "spa breads," prepared to complete the diet of different spas, toasted bread, breads for the diabetic, and various biscuits), vegetable extracts, Heudebert soup, milk flour, prolamine and totus food, radiopaque and malt flour, cereal creams, soya flour, caffeine-free coffee, germinated barley, cocoa preparations, preparations for soups, gluten flours, etc. It is useful to have this wide range of well-tested preparations conveniently available for the medical profession in this country.

## VOCAL-ZONE NASAL CAPSULES

(London : Messrs. Meggeson & Co., Ltd., New Church Street, Bermondsey, S.E.16.)

These nasal capsules of Messrs. Meggeson form an ingenious method of applying oily drops to the nasal mucosa. The elongated end of a gelatine capsule is cut off, and the patient then throws his head well back or lies down and injects the contents well into the nostril by squeezing the capsule; the contents consist of menthol, carbolic, ol. pini and cinnamon in liquid paraffin, and are well calculated to be of value in the treatment of nasal catarrh, colds, laryngitis, hay fever, etc.

## MOBILE X-RAYS

(London : Messrs. Mobile X-Ray and Diathermy Ltd., 13 Park Walk, Chelsea, S.W.10.)

The equipment of the Mobile X-Ray Co. consists of X-Ray and diathermy apparatus conveniently accommodated in a motor-car, and the electric current necessary is obtained from a dynamo, mounted in front of the radiator, which can be linked up and driven by the engine of the car. X-Rays can therefore be taken in any house anywhere, independent of an electric supply, and the negative can be handed to the patient's practitioner within half an hour of the arrival of the mobile X-Ray unit. The negatives we saw were excellent, and the fees charged are very moderate.

## OPENING OF NEW PREMISES OF MESSRS. LEWIS

(London : Messrs. H. K. Lewis & Co., Ltd., 136, Gower Street, and 24, Gower Place, W.C.1.)

A representative gathering of members of the medical profession and scientists assembled on July 9th at the invitation of the directors of the company to a "house-warming" at the new premises at the well-known corner of Gower Street and Gower Place. Sir Gregory Foster, formerly Provost of University College and Vice-Chancellor of the University of London, presided during the more formal part of the proceedings, and Dr. H. R. Kenwood, Emeritus Professor of Hygiene to the University, gave an interesting address on "Text-books and Education." Sir Gregory Foster referred to his long acquaintance with Messrs. Lewis, which began as far back as 1881. He outlined the origin and development of the scheme which had resulted in the present building, and congratulated the directors on the realization of a large part of their efforts, and on their success in maintaining the high traditions for which the name of Lewis was noted throughout the world. He also congratulated University College on having at its doors an institution so helpful in their educational work. Professor Kenwood also referred to his long association with Lewis's, as student, teacher and author. Mr. H. L. Jackson, the present chairman of the company, and a nephew of Mr. H. K. Lewis, the founder, said that after 87 years of steady growth and some earlier extensions they were at last housed in a suitable and becoming building, including accommodation for authors, editors, publishers, printers and booksellers, and users of books.

# THE PRACTITIONER

No. 759

SEPTEMBER, 1931

Vol. CXXVII

## The Value of Post-Graduate Medical Education

BY SIR HENRY SIMSON, K.C.V.O., M.B., F.R.C.P.,  
F.R.C.S.E., F.C.O.G.

*Dean of the West London Post-Graduate College; Obstetric Surgeon  
to the West London Hospital; Consulting Surgeon to the Hospital  
for Women, Soho Square.*

WHEN anybody wishes to enter a profession, be it Medicine, the Law, the Army, the Navy or the Church, it is necessary for such a person to pass certain examinations and so qualify himself to practise that profession; but no one will aver that the mere passing of an examination can guarantee that a person having done so is really capable of practising that profession. It is also a well-recognized principle that any advances made in a profession are usually accompanied by a further enquiry into the knowledge possessed by anyone who wishes to make such an advance. Take the Army as an example; at each step for promotion courses of special studies and examinations have to be undertaken and passed, and I make bold to say that in no profession more than in the medical profession is post-graduate study more necessary in order that practitioners may keep abreast of the advances which are constantly being made in the methods of treating disease.

There are several methods by which post-graduate

education can be obtained: First, a very old and very practical one is that a young practitioner should become an assistant to or go into partnership with an older man and by practical experience in a busy general practice learn how to put into effect the knowledge he has gained during his years of undergraduate study. Another well-established method is for a young practitioner, immediately after qualifying, to obtain a post as house-physician or house-surgeon in a hospital. These posts are held for six months or a year, and the amount of experience gained in this short time is probably greater than would be gained in five or six years of an assistantship in general practice. There are very obvious disadvantages in both of these methods: only a limited number of picked undergraduates are successful in obtaining house appointments, and the knowledge gained by an assistant entirely depends upon the experience of his senior partner.

There are, however, some other methods of much greater importance: the first has been for many years well recognized on the Continent and particularly in Vienna. The post-graduate school at Vienna has a great reputation and attracts medical practitioners from every part of the world to a large hospital of over a thousand beds, with all the leading physicians and surgeons of Vienna on its staff.

After the passing of the important National Health Insurance Act twenty years ago, a large number of medical men and women became panel practitioners. Within recent years the Ministry of Health came to the conclusion that some form of post-graduate study was necessary in order that the medical service supplied under the Insurance Act should be effective, and when Mr. Neville Chamberlain was Minister of Health an influential committee was appointed to advise the Ministry on the question of post-graduate education. This committee has made certain recommendations,

and it is quite clear from these recommendations that the ideal which this committee has in view is that which has been found so successful in Vienna. I have no hesitation in saying that this method holds out possibilities which could not be obtained in any other way. A great Imperial Post-Graduate College, situated in London and staffed by the leading men in the profession, equipped with laboratories for research and giving facilities for original work, is an inspiring ideal, and I am glad to say that such a hospital will soon come into being.

There are, of course, still difficulties to be overcome; no great scheme can ever come into being without having difficulties to overcome. Not only will a very large sum of money be necessary, but a representative medical and surgical staff will have to be found, and here London presents a difficulty quite of its own, inasmuch as there are a large number of famous undergraduate hospitals which always will attract their own most brilliant students. Once, however, an "Imperial Post-Graduate Hospital" becomes an established fact it will certainly draw to it the best brains in the country.

In an enormous centre such as London, there is always a very large amount of clinical material available for post-graduate education; but it is difficult for any practitioner coming to London to make the best use of this material, as it is widely scattered about over such a large area. In order to meet this difficulty, the Fellowship of Medicine was started just after the War, with a central office, which is housed at present in the premises of the Royal Society of Medicine at the end of Wimpole Street. The Fellowship is undoubtedly doing very valuable work; its indefatigable secretaries are in touch with all the hospitals in London, and throughout the year special intensive courses are arranged in these hospitals. Any practitioner who wishes to come up to London for a course

of post-graduate study has simply to write to the secretary of the Fellowship, stating particulars of the course of study he wishes to pursue and the time he wishes to be in London, and the secretary is able to send him details of whatever courses are available. Taken as a whole, this method of post-graduate education has proved of great value, but it suffers from the fact that it cannot supply all its facilities under one roof.

Post-graduate education from the general practitioner's point of view is quite distinct from that of the newly-qualified practitioner who, finding that he has received only rudimentary instruction during his undergraduate career, wishes to increase his practical knowledge by spending six months or a year at some large post-graduate centre, such as Vienna. It is also different from the needs of the practitioner who has been for some years in practice and has perhaps been appointed to the staff of his local hospital, and wishes to increase his knowledge in some special branch of medicine or surgery.

What the great majority of general practitioners want is a place where they can go and see and examine a large number of cases of every kind of disease in a short time. There are certain difficulties standing in their way: First of all, the general public in this country have not been educated up to recognize the value of post-graduate education. There are still a large number of people who will say that Doctor So-and-so cannot be a really good doctor because he finds it necessary to go back to hospital. In America, on the contrary, the general public are quite alive to the importance of post-graduate study for medical practitioners. There are several post-graduate societies in America, and nearly every year two or three hundred members of one or other of these societies come over to Europe together and make a tour of important medical centres on this side of the Atlantic. In

conversation with these practitioners, one has been told that the attitude of mind of their patients is that unless a medical man takes advantage of one of these tours every now and then, his reputation as a live and progressive man is certain to suffer. Public opinion in this country certainly requires education on this important point.

Another difficulty arises out of the fact that a general practitioner experiences some difficulty in finding time for post-graduate study. The necessarily uncertain nature of his professional engagements makes it difficult for him to be certain of being able to get away at any particular time; confinements have to be booked several months ahead, a bad case of pneumonia may hold him up, and there is also the expense to be considered. Unless he happens to be in a partnership, the practitioner has to pay a locum tenens while he is away, and there are also the incidental expenses associated with living away from home. The average general practitioner, not being a rich man, has generally to decide, therefore, whether he should curtail a hard-earned holiday by spending a fortnight of it in post-graduate study, and, human nature being what it is, golf clubs or a fishing rod generally gains the day.

Looking at post-graduate study from the point of view of the Ministry of Health, as one of the chief duties of the Ministry is to provide an efficient medical service under the National Insurance Act, there can be no doubt that the efficiency of this service would be increased if arrangements could be made for every doctor working under the Act to be given an opportunity every two or three years, free of expenses, of having a fortnight's post-graduate course in a general hospital. As an illustration, I may quote the experience of a well-known life insurance company. A good many years ago now this company found that it was making large profits, and the directors discussed how these



profits could be best used. The first thing which they went into was whether they could reduce their premiums; they asked their actuary to go into the matter, but were told that if they reduced these premiums by any appreciable amount the profits would practically disappear. An alternative suggestion was accordingly adopted, namely that the benefits should be increased by supplying a trained nurse for the first fortnight of an acute illness, and in addition all their clients were given the opportunity of being overhauled by one of the company's doctors twice a year. As a result their liabilities at once decreased and their profits increased even more.

What is really wanted to meet the needs of the general practitioner and the Ministry of Health is a general hospital of 200 or 300 beds with daily operations and large out-patient and casualty departments situated in an accessible part of London. Of course, practically any of the large undergraduate teaching hospitals in London would fill this need, were it not for the fact that it is quite impossible to combine post-graduate teaching with undergraduate teaching. Undergraduates need lectures and elementary instruction in diagnosis. The last thing a post-graduate wants is a lecture, and discussions on prognosis and treatment are of far greater value than the, to him, comparatively simple matter of diagnosis.

# Post-Graduate Education in London

By R. SCOTT STEVENSON, M.D., F.R.C.S.E.

POST-GRADUATE medical education in London has taken a great stride forward during the past year on the acceptance by the Government of the recommendation by a special committee (appointed by Mr. Neville Chamberlain in 1925) that a British Post-Graduate Hospital and Medical School should be established at the Hammersmith Hospital, Ducane Road, Shepherd's Bush, a modern hospital of 400 beds, formerly under the Poor Law authorities, and now under the control of the London County Council. The Government is to grant the sum of £250,000 from public funds to build and equip the medical school to be associated with the hospital, and is to make provision for grants through the University of London towards the maintenance of the medical school on lines already applied to comparable institutions of university rank. The Minister of Health, after consultation with the London County Council and the Senate of the University of London, has appointed a Provisional Organization Committee to consider and report upon the action requisite to lead up to the planning and construction of the medical school, and upon the form of government appropriate to the hospital and medical school, with special reference to the position of the London County Council as the local authority responsible for the hospital, and to the position of the University of London in relation to the medical school.

The chairman of this committee is Viscount Chelmsford; the Ministry of Health is represented by Sir George Newman, chief medical officer, and Mr. M. Heseltine, an assistant secretary; the London County

Council by Dr. Florence Barrie Lambert, Sir William Ray, Mr. Angus N. Scott, and Mr. L. Silkin; and the University of London by the Rev. Dr. Scott Lidgett, vice-chancellor-elect, Mr. Sidney L. Loney, chairman of convocation and deputy chairman of the court, Mr. H. L. Eason, superintendent and senior ophthalmic surgeon, Guy's Hospital, and Dr. Edwin Deller, principal of the university. The other members of the committee (all of them members of the medical profession) are : Mr. Donald J. Armour, senior surgeon, West London Hospital; Lady Barrett, Dean of London (Royal Free Hospital) School of Medicine for Women; Mr. Comyns Berkeley, consulting surgeon to the Middlesex Hospital; Sir Robert Bolam, honorary physician to the Skin Department, Royal Victoria Infirmary, Newcastle-on-Tyne, and past Chairman of Council, British Medical Association; Dr. H. B. Brackenbury, Chairman of Council, British Medical Association; Dr. H. G. Dain, chairman of Insurance Acts Committee of the British Medical Association; Lord Dawson of Penn, Physician-in-Ordinary to the King, and extra physician to the London Hospital; Dr. H. R. Dean, professor of pathology, Cambridge University; Sir Walter Morley Fletcher, secretary of the Medical Research Council; Mr. G. E. Gask, professor of surgery, London University, and surgeon to St. Bartholomew's Hospital; Sir Thomas Horder, Bart., Physician-in-Ordinary to the Prince of Wales, and physician to St. Bartholomew's Hospital; Dr. F. N. Kay Menzies, medical officer of health for the County of London; Lord Moynihan of Leeds, President of the Royal College of Surgeons of England, consulting surgeon to Leeds General Infirmary; Mr. H. J. Paterson, senior surgeon, London Temperance Hospital, and honorary secretary of the Fellowship of Medicine and Post-Graduate Association; Dr. Harold Pritchard, senior physician to the West London Hospital; and Sir Holburt Waring, senior surgeon to St. Bartholo-

mew's Hospital. Mr. Heseltine is the secretary, and all communications on the business of the committee should be addressed to him at the Ministry of Health, Whitehall, S.W.1.

The first step towards organizing the hospital has been the appointment of a superintendent, bearing in mind the functions he will have to assume with the development of the hospital in association with the post-graduate medical school. The excellent choice has been made of Sir Thomas Carey Evans, F.R.C.S., who has had the advantages of education at both a provincial and a metropolitan medical school, service in the Indian Medical Service and experience of consulting practice in London, and who in a very high position in India disarmed the suggestion that his appointment was a lucky one by the display of great administrative ability.

It has been said by some critics that the Post-Graduate Hospital at Shepherd's Bush is inconveniently situated; but what is really meant is that its situation is an unfamiliar one, for it is much nearer to the centre of London than, for instance, the Medical Centre is to the centre of New York, and it is as easily reached as the Prince of Wales's Hospital, Tottenham, or the Miller Hospital, Greenwich, both of which have very successful post-graduate courses associated with them. In addition, a residential hostel in a convenient situation is to be provided for the post-graduate students of the hospital. In the near future, therefore, it should be no longer possible to read, in a journal so friendly to British medicine as the *Medical Journal of Australia*, the following editorial comment<sup>1</sup>:—

“Graduates desirous of undergoing courses of training in special branches of medical science have found that they can best obtain the kind of training they seek in European centres or in the United States of America. In such cities as Vienna, Berlin, Paris and New York adequate provision is made for post-graduate students.

In Great Britain the same satisfactory arrangements have not existed. . . This state of affairs is to be deplored, as the standard of British medicine is certainly equal to that of any other country."

As a matter of fact, even to-day the medical post-graduate facilities in London are very much better than has sometimes been suggested. The Fellowship of Medicine and Post-Graduate Association, which is associated with some fifty London general and special hospitals, has been in existence for a good many years, and its officials from their wide experience are able to give information not only about the available post-graduate courses in London, but about living accommodation, how best to get from hotel or rooms to the hospitals the post-graduate student is working at, and also about post-graduate courses at foreign centres. It is unfortunate that all the hospitals in London to which post-graduates are admitted are not associated with the Fellowship of Medicine, and, indeed, some have recently withdrawn from it. It is advisable, therefore, for an intending post-graduate student not to buy the comprehensive ticket of the Fellowship until he has ascertained whether the hospital at which he hopes to work is included in its scope. The address of the Fellowship of Medicine is Room 28, Royal Society of Medicine, 1 Wimpole Street, London, W.1. The work and the usefulness of the Fellowship of Medicine should by no means be at an end when the new Hammersmith Post-Graduate Hospital and Medical School is in full working order. Many post-graduates coming to London will find their special needs perhaps even better met at some of the post-graduate courses at other hospitals, for all post-graduates do not want the same sort of instruction and experience : some are preparing for higher diplomas or for an examination for promotion in one of the services ; others are general practitioners desirous of refresher courses to bring their general knowledge up

to date or of adding the knowledge of some special subject to their general work. The following courses have been arranged by the Fellowship of Medicine up to the end of the present year, and a detailed syllabus of each course is obtainable at the office of the Fellowship :—

**DISEASES OF THE CHEST** (Sept. 7 to Sept. 12).—Brompton Hospital. All day. Fee £3 3s.

**PSYCHOLOGICAL MEDICINE** (Sept. 8 to Oct. 3).—Bethlem Royal Hospital. Tues. and Sat. 11 a.m. Fee £1 1s.

**DISEASES OF INFANTS** (Sept. 14 to Sept. 26).—Infants' Hospital. Afternoons. Fee £3 3s.

**OPHTHALMOLOGY** (Sept. 14 to Oct. 10).—Central London Ophthalmic Hospital. Afternoons. Fee £3 3s.

**MEDICINE, SURGERY & THE SPECIALITIES** (Sept. 14 to Sept. 26).—Westminster Hospital. All day. Fee £5 5s. (Men only.)

**MEDICINE, SURGERY & THE SPECIALITIES** (Sept. 28 to Oct. 10).—Metropolitan Hospital. All day. Fee £3 3s.

**M.R.C.P. EVENING COURSE** (Oct. 13 to Dec. 4).—London Medical Society Lecture Room. Tuesdays and Fridays, 8.30 p.m. Fee £6 6s. for Course, or 10s. 6d. per Lecture.

**F.R.C.S. (FINAL) EVENING COURSE** (Oct. to Nov.).—One evening weekly for six weeks. Dates, time, place and fee to be fixed later. (Limited to 24.)

**DISEASES OF THE EAR, NOSE AND THROAT** (Oct. 5 to Oct. 31).—Central London Throat, Nose and Ear Hospital. All day. Fee £5 5s. (Operative Class, £7 7s.; Peroral, £6 6s.; Pathology, £5 5s. : all strictly limited.)

**TROPICAL MEDICINE** (Oct. 5 to Oct. 24).—Hospital for Tropical Diseases. All day. Fee £8 8s.

**DERMATOLOGY** (Oct. 12 to Nov. 7).—St. John's Hospital. Afternoons. Fee £1 1s. (Practical Pathology arranged. Fee £4 4s.)

**CARDIOLOGY** (Oct. 12 to Oct. 24).—National Hospital for Diseases of the Heart. All day. Fee £7 7s. (Limited to 20.)

**GYNÆCOLOGY** (Oct. 12 to Oct. 24).—Chelsea Hospital for Women. Mornings and/or afternoons. Fee £5 5s.

**DISEASES OF CHILDREN** (Oct. 19 to Oct. 31).—Hospital for Sick Children. Mornings. Fee £5 5s. (Minimum of 12.)

**MEDICINE, SURGERY AND GYNÆCOLOGY** (Nov. 2 to Nov. 21).—Royal Waterloo Hospital. Afternoons and some mornings. Fee £3 3s.

**NEUROLOGY** (Nov. 2 to Nov. 28).—West End Hospital for Nervous Diseases. Daily 5.0 p.m. Fee £2 2s. (Minimum of 10.)

**OPHTHALMOLOGY** (Nov. 9 to Nov. 28).—Royal Westminster Ophthalmic Hospital. Afternoons. Fee £4 4s.

**DISEASES OF THE CHEST** (Nov. 16 to Nov. 28).—Victoria Park Hospital. All day. Fee £2 2s.

**VENEREAL DISEASES** (Nov. 16 to Dec. 12).—London Lock Hospital. Afternoons and evenings. Fee £2 2s.

**PROCTOLOGY** (Nov. 23 to Nov. 28).—St. Mark's Hospital. All day. Fee £3 3s.

DISEASES OF INFANTS (Nov. 30 to Dec. 12).—Infants' Hospital.  
Afternoons. Fee £3 3s.

DERMATOLOGY (Nov. 30 to Dec. 12).—Blackfriars Skin Hospital.  
Afternoons. Fee £1 1s.

In addition to these there are during the year special post-graduate courses on radium therapy at the Radium Institute and Mount Vernon Hospital, the Cancer Hospital, the Westminster and some other of the general hospitals; on obstetrics at Queen Charlotte's and the London Maternity Hospital; on fevers at the various fever hospitals under the London County Council; on nervous diseases at the Tavistock Clinic; and on physiology and bio-chemistry at University College.

Special courses for both parts of the examination for the F.R.C.S. are held at most of the undergraduate hospitals, but they may be attended by post-graduates; there is also teaching for this diploma at the Seamen's Hospital, Greenwich. For the M.R.C.P., courses lasting six weeks are held at the London, Guy's, and King's College Hospitals. In order to meet the demands of practitioners unable to attend these all-day courses, the Fellowship of Medicine arranges a bi-annual series of lectures for the M.R.C.P. These are bi-weekly at 8.30 p.m., the course lasting eight weeks, with first-class lecturers, but of course they do not pretend to cover the whole ground necessary. There is also an evening F.R.C.S. course, once weekly for six weeks, designed as a final revision course.

The following are the arrangements for teaching for the other diplomas; all courses for these special diplomas are open also to those who are not preparing for the examinations and are therefore useful for post-graduates interested in the various special subjects. D.L.O.—The Central London Throat, Nose and Ear Hospital holds twice a year a course of three weeks' duration, which includes clinical work, a practical operative class, and classes on peroral endoscopy and pathology. The regulations for the diploma demand

one year of special study of diseases of the ear, nose and throat, and the Hospital for Diseases of the Throat, Nose and Ear, Golden Square, and the Metropolitan Ear, Nose and Throat Hospital, Fitzroy Square, are also recognized for this purpose. **D.P.M.**—The Maudsley Hospital holds a course in two parts, each part lasting three months, and the Bethlem Hospital, now at Eden Park, Beckenham, gives two courses a year, of three months' duration. Three courses annually are organized in neurology by the National Hospital, Queen Square, each lasting eight weeks, and fulfilling the requirements for this diploma. **D.T.M.**—The London School of Hygiene and Tropical Medicine arranges two courses annually, each lasting for five months. **D.P.H.**—The London School of Hygiene and Tropical Medicine (University of London) and the Royal Institute of Public Health, Russell Square, provide facilities for this, the course covering a period of twelve months. **D.O.M.S.**—In order to sit for this examination, candidates must have attended the clinical practice of a recognized ophthalmic hospital, or the ophthalmic department of a general hospital, for at least twelve months. The five ophthalmic hospitals in London are all recognized hospitals for this purpose: the Royal London Ophthalmic Hospital, the Royal Westminster Ophthalmic Hospital, the Central London Ophthalmic Hospital, the Royal Eye Hospital, and the Western Ophthalmic Hospital. **D.M.R.E.**—Courses are held once a year, in October, at one of the medical schools. Particulars may be had from the secretary, British Institute of Radiology, 32 Welbeck Street, London, W.1. **D.G.O.**—The new Diploma in Gynæcology and Obstetrics is open to practitioners who have been qualified for not less than three years, and candidates must have been attached as a resident officer or clinical assistant to a recognized general hospital or maternity hospital. The regulations may be obtained from the secretary, Examination



Hall, Queen Square, W.C.1.

The West London Hospital, Hammersmith (not now to be confused with the Hammersmith Post-Graduate Hospital at Ducane Road, Shepherd's Bush), and the Prince of Wales's General Hospital, Tottenham, have had post-graduate colleges attached to them for many years, which, in spite of many difficulties, have done excellent work; the West London Hospital is at present engaged on a scheme for rebuilding and extending its post-graduate college. The dean of the West London Post-Graduate College is Sir Henry Simson, K.C.V.O., and the dean of the North-East London Post-Graduate College is Dr. T. H. C. Benians. The Hospital for Nervous Diseases, Queen Square, has gained a reputation as one of the best teaching institutions in London, and at its out-patient demonstrations, on five afternoons a week, fifty or sixty post-graduate students from all over the world are often present; these demonstrations are supplemented by courses of lectures on pathology, etc. Some of the twelve hospitals with undergraduate medical schools (such as the Westminster Hospital, noted in the list given above) hold post-graduate courses, designed as refresher courses, during the vacations, and old students of the hospital will find themselves particularly welcome there. At Guy's Hospital, Dr. Arthur Hurst has a famous weekly demonstration open to all post-graduates; at St. Bartholomew's Hospital Professor F. R. Fraser's round is open to post-graduates by invitation; and at St. George's Hospital there is a weekly demonstration in neurology open to post-graduates, Dr. James Collier alternating with Dr. Anthony Feiling.

#### Reference.

<sup>1</sup> Leading article : *Medical Journal of Australia*, January 10, 1931, i, 49.

# The Treatment of Pulmonary Suppuration

By A. J. SCOTT PINCHIN, M.D., F.R.C.P.

*Physician to the City of London Hospital for Diseases of the Heart and Lungs, Victoria Park, and to the West London and Hampstead General Hospitals,*

AND H. V. MORLOCK, M.C., M.D., M.R.C.P.

*Physician to Out-Patients at the City of London Hospital for Diseases of the Heart and Lungs, Victoria Park, and the Miller and Hampstead General Hospitals.*

PULMONARY suppuration, including under this general term suppurative conditions affecting the trachea, large and small bronchi, and parenchyma of lung, often presents extremely difficult problems as regards diagnosis and treatment, and calls for a great nicety of judgment in order that the best may be done for the patient, allowing the natural recuperative powers a chance, whilst endeavouring to help by the medical means at our disposal; yet not delaying surgical procedures until a time when the patient is so toxic that he is unable to stand an operation.

Despite the great advances recently made in chest surgery, it must always labour under the disadvantage of having to deal with a closed and more or less rigid cavity, which the most extensive plastic operations cannot completely obliterate, and though in non-suppurative conditions lobectomy is followed by sufficient expansion of the remaining lobe or lobes to fill the space, it is rarely in suppurative conditions that the pleura or other lobes are sufficiently unimpaired to allow this to take place. Moreover, nature not only dislikes the space left vacant by removal of organs from the chest, but also has an antipathy to foreign bodies introduced to take their place, so that pneumolysis and even air or gomenol oil may be followed by

suppuration and extrusion.

With the limitations of surgical methods in our minds, it is well to exploit all the more <sup>old</sup> conservative methods of treatment, with careful observation of the progress of the patient before we resort to operative measures.

The conditions to be considered here are : (1) Purulent tracheitis and bronchitis. (2) Bronchiectasis of all grades. (3) Suppurative pneumonitis. (4) Lung abscess. (5) Gangrene.

Although this article deals mainly with treatment, inasmuch as this varies with the condition present, a brief reference must be made to the etiology and differential diagnosis and, of even more importance, to the type of suppuration and its localization.

#### ETIOLOGY

*Suppurative tracheitis and bronchitis.*—The line of demarcation between an acute inflammation and suppuration is fine, and it is extraordinary that infections lead comparatively seldom to this condition; probably this is due to the strong ciliary action of the bronchial mucosa. Influenzal infections characterized by intense inflammation of the tracheal and bronchial mucous membranes, though frequently followed by pneumonia, are much less often followed by suppuration in the trachea, bronchi or lungs. Occasionally a residual infection may light up; on three occasions we have seen pure pneumococcal unaerated pus spat up in large quantity after an operation, simulating the spitting up of an empyema—none of the cases had any physical signs except of bronchitis of large tubes, and in every case the condition ceased in a day or two. If the condition does not clear, the suppuration damages the mucosa, the ciliary action does not take place, the walls become infected and dilated, and bronchiectasis may follow.

*Bronchiectasis.*—It would appear that the common

cause of an acquired unilateral bronchiectasis is damage to the bronchial wall by an acute pneumonia or broncho-pneumonia; occasionally it may be secondary to inhalation of foreign body, though we are not in agreement with Chevalier Jackson that the majority of unilateral cases are due to this cause.

In bilateral bronchiectasis the condition may start with a basal broncho-pneumonia or bronchiolitis. Such a condition is not uncommonly seen in young people with slight signs of dilatation at both bases, often with a history of recurrent attacks of pneumonia, and in whom often a pure culture of an infecting organism may be found. The chronic infection leads to dilatation; the mucous membrane of the bronchial passages becomes turgescient above the inflammation and prevents the free outlet of the secretions, with the result that we get the circular grape-like dilatations behind the obstruction (an important point in treatment); loss of cough reflex in this area and secondary infection usually complete the picture. Again the sequence may be tracheitis, bronchitis, bronchiolitis, or dilatation, secondary to septic foci in the upper respiratory tract, teeth, tonsils, sinuses and post-nasal fossæ.

*Lung abscess.*—The commonest cause of lung abscesses is an acute respiratory infection. It is impossible to say if this is a pneumonic condition which progresses to a suppurative pneumonitis, and so to abscess formation, or if from the first it is a suppurative pneumonitis; in necropsies of patients dead of influenzal pneumonia it is not uncommon to see the process of suppuration commencing in some part of the lung. Probably the condition is not uncommon in influenza as a suppurative pneumonitis; not infrequently after an attack of influenza, which may be comparatively mild but with much cough, about the seventh to tenth day, after a slight hæmoptysis, a small amount of offensive sputum is expectorated,

followed by cure of the condition.

By suppurative pneumonitis is meant a condition in which the parenchyma of the lung is infiltrated with pus, but has not disintegrated; such an area has the potentiality of recovery and is found at the periphery of abscesses and around bronchiectatic dilatations.

Next in order of frequency in the etiology of abscess is an operation performed under general anæsthesia, particularly operations on the upper respiratory passages. There is considerable controversy as to the route of infection in these cases; we favour the view that it takes place by way of the air passages, while others contend that the infection is *via* the blood stream.

Foreign bodies aspirated into the bronchi may give rise to abscess formation; this factor is more common in America than in this country, but the possibility of this as causation of an abscess must always be kept in mind, for in such case the first therapeutic measure to be contemplated is its removal. Bronchial obstruction, from whatever cause, neoplasm, gummatous stenosis, pressure from without (*e.g.* aneurysm), will cause suppuration to take place in the lung parenchyma and bronchial walls behind the obstruction. The most common form of obstruction in the present day is new growth of the bronchus.

Trauma to the chest and drowning with recovery are other occasional causes of lung abscess.

#### SYMPTOMATOLOGY OF LUNG ABSCESS AND BRONCHIECTASIS

In lung abscess, the history is generally as follows: An acute respiratory illness (perhaps following operation) is followed by fever, pain in chest, and cough. The cough is at first dry; later purulent sputum is expectorated, usually in association with slight hæmoptysis. It is the occurrence of this purulent sputum which is the chief point in the diagnosis of the

condition. The sputum when first raised may be very offensive and considerable in amount; on the other hand, neither the odour nor the amount may be striking. Therefore, in considering the diagnosis of an obscure respiratory illness, the possibility of foul sputum having been raised must be inquired into, for it is not always present at the time of examination, and the history of its occurrence is seldom given spontaneously.

*Differential diagnosis.*—There are no physical signs diagnostic of lung abscess; they are usually those of consolidation, occasionally of cavitation, and not uncommonly those of pleural involvement or serous or purulent effusion. The condition may be confounded with tuberculosis, but a tuberculous lesion breaking down to the extent of causing purulent sputum is almost certain to contain tubercle bacilli. *Neoplasm of lung*: If a growth has caused suppuration behind an obstructed bronchus, the condition, being an abscess plus a new growth, can only be differentiated by bronchoscopic examination, occasionally by lipiodol injection, or the appearance of metastases. *Gumma*: Wassermann reaction and examination of sputum. *Interlobar empyema*: The physical signs will be present in the region of an interlobar septum, and radiological examination is of value. *Bronchiectasis*: This is distinguished by its long history (for the most part apyrexial, accompanied often by periods of high temperature when the sputum is retained), the absence of leucocytosis, by lipiodol injection and bronchoscopic examination.

The diagnosis of pulmonary suppuration having been made, the next step toward treatment is to determine the type of suppuration to be dealt with, as the treatment will vary according to the type.

*Bronchi*

- |  |                                   |
|--|-----------------------------------|
| 1. Suppurative tracheitis and<br>bronchitis. | 3. Apical bronchiectasis.         |
| 2. Dry bronchiectasis and<br>bronchiectasis. | 4. Early basal bronchiectasis.    |
|  | 5. Advanced basal bronchiectasis. |

*Lungs (Ballon)*

- |                                 |                           |
|---------------------------------|---------------------------|
| 1. Single abscess.              | 4. Multiple abscess.      |
| 2. Bronchiectatic abscess.      | 5. Secondary to neoplasm. |
| 3. Abscess with bronchiectasis. | 6. Tuberculosis.          |

One is able to determine the type of suppuration with which one is dealing by lipiodol injection of the bronchial tree, bronchoscopic examination and a bronchoscopic pneumogram. By these means also the lesion must be localised. Antero-posterior and lateral views must be taken radiologically both before and after lipiodol.

It may happen in bronchiectasis, and is usual in abscess, that the inflammatory condition of the passages does not allow the entrance of the lipiodol; in these cases the bronchoscopic pneumogram is invaluable.

H. M. developed a lung abscess twelve months ago at the right base. Lipiodol failed to reveal the exact site. Medical treatment was carried out for two months, and the patient was well, but had occasional hæmoptyses. He then had a large hæmoptysis, and the surgeon was asked to open the abscess; a two-stage operation failed to locate the abscess, and the hæmorrhages recurred later. A phrenic evulsion was then done with a good rise of diaphragm. The patient was much better, and was sent to Torquay, where he had a severe hæmorrhage. He was taken in again, and an artificial pneumothorax was done, with good collapse of the whole of the upper part of the lung, but the hæmorrhages recurred. We then examined him with a bronchoscope, and found a posterior branch of the lower lobe bronchi with a congested opening and exuding pus. A sound was passed down this, and lipiodol injected, and the lateral view now shows a cavity outlined with lipiodol in the lower posterior part of the lung.

(1) *Suppurative bronchitis and tracheitis*.—The bronchoscope renders the treatment of the bronchial mucus membrane as practicable as the more accessible mucus membranes. Drainage, introduction of anti-septic oily solutions (such as 10 per cent. gomenol) or swabbing with antiseptics will do much to render the local condition more healthy.

(2) *Dry hæmorrhagic bronchiectasis and atelectactic bronchiectasis*.—Apart from the hæmorrhage associated with these conditions patients are not inconvenienced

and seldom require treatment except at the time of bleeding.

(3) *Apical bronchiectasis* from its position tends to keep drained, and seldom becomes as heavily infected as the basal varieties. If it does so the treatment is similar to that suggested in the latter form.

(4) *Basal bronchiectasis of small extent*.—In these cases, especially when bilateral, if the dilatation is only of slight extent it is difficult to decide the best treatment. They are usually young subjects, and one hesitates to recommend phrenic evulsion; we do not know to what degree they may recover, neither do we know that they proceed to the more severe type, lipiodol examination being of too recent origin for these cases to have been followed long enough. The course we follow is to inject the lipiodol every three to four weeks to wash out the dilatation, and, if a pure organism is isolated from the sputum, to give an autogenous vaccine, with the idea of avoidance of the recurrent pneumonic attacks they frequently have, each of which attacks is liable to increase the disease.

(5) *Extensive bronchiectasis*.—These may be divided into the following :—

(A) The group who bring up foul sputum but the sputum is not retained at any time, who seldom have febrile bouts and show few toxic symptoms; by the use of postural drainage, creosote, or other disinfectants by the mouth; creosote chamber, and occasional injections of lipiodol, they are able to lead fairly comfortable and useful lives. Bronchoscopic drainage and lavage are definite adjuncts in the treatment.

(B) Those patients in whom the bronchiectasis is accompanied by febrile bouts and marked toxic symptoms. Postural drainage is of value, but bronchoscopic drainage and lavage are more useful here than in the previous type. When viewed through the bronchoscope it will be seen that above most of the bronchiectatic dilatations is a bronchus obstructed by inflam-



matory œdema in the wall. By way of the bronchoscope, these orifices may be dilated and a drainage tube passed through the obstruction, and the pus evacuated; the instillation of gomenol appears to help in the evacuation of the contents for some days, as evidenced by the increase of sputum.

(c) The severest cases are those in which the symptoms are very marked, and the sputum very foul; not uncommonly these are of the type with secondary bronchiectatic abscess. The life of these unfortunates, who, with their ill-health and constant fœtor, are rendered veritable "lepers" in society, is such that they are anxious enough to accept any reasonable risk in order to obtain some improvement.

When faced with the problem of the "social leper" who is not only willing to take risks, but is anxious that something should be done, probably the best plan is to proceed, step by step, with compression therapy, and finally consider a cauterary lobectomy, waiting a reasonable time after each step in order to ascertain the amount of ground gained; with each successful advance the patient's general condition improves, and also his morale is increased to face the next offensive.

The attack may be started with the least formidable of the procedures available, namely, artificial pneumothorax. If only partial collapse is obtained because of adhesions, these adhesions may be cauterized through the thoracoscope, as we have described elsewhere. Occasionally this collapse is sufficient to relieve the patient, and one is then faced with the problem of keeping this collapse permanent (that is, repeated refills for many years). One attempts to get over this difficulty by replacing the pneumothorax by an oleothorax, using gomenol. The danger of this treatment by artificial pneumothorax lies in the possible development of a pyopneumothorax (this will be referred to again when dealing with lung abscess). If the pneumothorax, as is usually the case, only produces slight

alleviation, or if an artificial pneumothorax is considered inadvisable from the first, the next step is a phrenic evulsion. In cases where the bronchiectasis is basal the success obtained by this measure is often very striking, the condition being relieved to such an extent that the patient is not prepared to take further risks. In quite as many cases, however, success is only partial, and a further operation has to be considered, namely a thoracoplastic one. According to the extent of the lesion, so will the extent of the thoracoplasty vary. Here again it is impossible to say how great will be the relief afforded by this operation until the operation has been done. If, after the procedure, the symptoms have not been sufficiently relieved to make life safe and comfortable for the patient, the operation of cautery lobectomy must be considered. This surgical measure is one that is so severe that at present it is seldom that the physician takes the responsibility of advising the patient to face it. A procedure which is less radical, but which often meets with considerable success, especially in children, is an extrapleural pneumolysis.

*Lung abscess.*—In this, as in bronchiectasis, the *sine qua non* of treatment is free drainage. If not obtainable *per via naturalis*, external drainage must be resorted to. An important point to remember in treatment is that 40–50 per cent. of the cases, once they have made communication with a bronchus and are draining themselves by this route, will heal by conservative medical treatment. The percentage is probably even greater if we take into account the number of undiagnosed cases.

The medical treatment resolves itself into supporting the general condition of the patient, particularly the cardio-vascular system, giving stimulating expectorant mixtures, with strict avoidance of any sedative which decreases the cough reflex, and particular attention to postural drainage and general hygienic measures as in

tuberculosis.

An incomparable adjunct to this treatment is the drainage of the abscess by means of a drainage tube passed through the "bronchus of drainage" under guidance of the bronchoscope. The drainage is done twice weekly, if possible. The instillation at the same time of 10 per cent. gomenol seems to aid, and, in cases where we have suspected the presence of a post-influenzal abscess, has seemed to expedite resolution. Drainage is successful in those cases to which it applies, not only on account of the aspiration of the pus at the time of the bronchoscopic drainage, but also because the drainage opens up the bronchus leading to the abscess, which, owing to inflammatory changes, obstructs the passage of the pus; the procedure is not applicable in those cases in which the abscess is situated at the periphery of the lung. This line of treatment should always be given its chance before considering any surgical interference except in very exceptional circumstances; if the patient is improving, it should be continued for at least two months from the onset of the abscess. Even in abscess coming under observation some considerable time after its onset this procedure should be given a trial, for it often meets with complete success, and it is because of the success of these conservative measures in so large a proportion of cases that practically all authorities on this subject are in agreement that these measures should be continued for 8-12 weeks unless the patient is obviously losing ground.

Further, not only does medical treatment hold out a very considerable chance of success, but it also gives time for the abscess to become more definitely "shut off" and so more amenable to surgery.

*Drugs.* — While the above-mentioned medical measures are being carried out, the drugs which are reputed to be of value in the treatment of this condition should also be tried. For instance, emetine,

1 grain daily for 8 to 12 days. In some cases we have seen dramatic results following the administration of this drug; in more cases we have seen it to be of no value; yet we have never seen it do harm.

In those cases in which spirochaetes are recovered from the sputum, the giving of arsenical preparations intravenously has been recommended; to this procedure the same remarks apply as to the use of emetine.

*Artificial pneumothorax.*—When the abscess is well defined and is draining through a bronchus, and is situated near the root of the lung, artificial pneumothorax induced and kept up for some months will often “cure” the condition. The danger is the possible production of a pyopneumothorax. Although this complication is looked upon as a very dangerous one, we have seen it occur four times, and, on three occasions, after drainage of the pyopneumothorax, a complete recovery was made. It is interesting to note that a Continental worker has suggested and carried out with success in a number of cases this production of a pyopneumothorax with subsequent drainage as a curative measure for the treatment of lung abscess.

It must be remembered that no method of compression of the lung will be satisfactory unless there is a free exit into the bronchial tree. Thoracoplastic operations and phrenic evulsions are seldom successful in procuring the healing of an abscess. The value of these operations is to be found in the obliteration of a cavity which may be left when the abscess is drained externally.

In our experience the most successful surgical procedure is external drainage, carried out under a local anaesthesia. It should be performed as a two-stage operation. Stage one, the pleura should be explored, and, if found free, it should be plugged so as to cause adhesions to form. When the adhesions have shut off the pleural cavity four to six days later, the secondary

stage of opening the abscess and inserting a drain should be carried out. Flick's suggestion that, at the time of the first procedure, a large portion of two or three of the neighbouring ribs should be resected so that compression is brought to bear on the abscess seems a very useful additional procedure.

If, at the first stage, the pleura is found firmly adherent, as is not uncommon, then drainage may be carried out at this stage.

We feel that more can be done than has been done in the past for these cases by the use of systematic bronchial drainage and medication. This method has long been advocated by Chevalier Jackson, and is used much more in America than in this country.

A general anæsthetic should never be used. It is unnecessary and dangerous; it often makes the patient ill for days, and may easily be the cause of a spread of infection. Patients with malignant growths in the bronchus, after bronchoscopy with a general anæsthetic, often seem to be particularly "knocked out."

Given a suitable local anæsthetic, the passing of a bronchoscope is not at all distressing to the patient; patients generally prefer it to a lipiodol injection, and in a series of 200 examinations—old, young, nervous and phlegmatic—we have had no case who has made any complaint of inconvenience or pain. We employ the technique of Haslinger, which he kindly demonstrated to us in Vienna. A small dose of atropine and morphine is given before the first examination. The passages are anæsthetized with cocaine and the patient assured that the procedure is not either dangerous or painful. The patient walks to the table and can walk away after the operation, and is quite prepared for further treatment if and when necessary. As a routine we use the Haslinger bronchoscope; this has proximal illumination, and extension tubes render it possible to reach the smaller bronchi; the light is excellent, does

not dazzle the eye or become obscured with secretion; moreover, it shines down the bronchial tree so that the branches can be seen to their full extent. We occasionally use the Jackson instrument in cases where a local light is an advantage, as, for example, obtaining



FIG. 1.—Ordinary X-ray of lung abscess. Lipiodol failed to enter this area.



FIG. 2.—Bronchoscopic pneumogram (prone). Upper area is abscess, lower areas have massed alveolar distribution.



FIG. 3.—Same. Lateral view (upright).  
Three levels show : air, pus, lipiodol.

pieces of growth for biopsy, but for general purposes the former instrument is the one of our choice.

The skiagrams show the value and use of the bronchoscopic X-ray lipiodol picture (called for brevity a bronchoscopic pneumogram). Usually it is the only means of getting the cavity filled with lipiodol, which is essential for accurate localization if the case should come to operation and for deciding if it is suitable for operation.

Our thanks are due to Drs. J. V. Sparks and F. Wood for the skiagrams.

# On Urinary Obstruction

By J. B. MACALPINE, F.R.C.S.

*Honorary Surgeon and Surgeon in Charge of the Genito-Urinary Department, Salford Royal Hospital, Manchester.*

TWO statements are monotonously reiterated in our teaching on urinary obstruction: the one that it causes back pressure on the kidney, and the other that such back pressure must be relieved gradually. To particularize further or elaborate these elementary empiricisms is rarely attempted, even though there is much important knowledge which can aid the intelligent application of enunciated principles instead of leaving them as rule-of-thumb procedures. I propose therefore to examine at slightly closer range one or two of the many processes in action in the production of the very complex condition of surgical uræmia.

Let us first picture the series of events leading up to renal obstruction in a patient with complete lower urinary retention. The bladder is, of course, in ordinary circumstances a hollow receptacle inserted in the excretory system which receives water passively from the kidney for the purposes of temporary storage. Once urine has entered the bladder its return to the ureter is forbidden by the mechanism at the lower end of that tube. This mechanism is a double one, partly muscular (sphincteric) and partly valvular (a curtain or cusp). Various writers attribute differing importance to the rôles played by these two factors. In different animals also they probably vary in importance. I believe that when the bladder is empty and there is therefore no intravesical pressure the muscular (sphincteric) mechanism is responsible for preventing any return of urine into the ureter. This view gains probability in that an empty bladder's muscle fibres are shortened and would therefore naturally embrace any



structure which traversed its wall. Such closure is therefore a vital process. When the bladder is partially distended the muscle fibres are lengthened and would tend to loose their hold on the intramural ureter. But now another, a valvular or mechanical hindrance, is substituted in the shape of the small curtain of mucosa which forms the lowest limit of the anterior wall of the ureter. For a cusp to be efficient there must be pressure on its surface. There is not any pressure in an empty bladder and the cusp is therefore incompetent till the bladder is partly filled, when the forces necessary to depress the valve cusp are supplied. Intravesical tension then holds it back against the posterior wall at the uretero-vesical junction. The greater the intravesical pressure the more firmly the orifice is closed. Valvular integrity does not depend on the strength of the fold of mucosa, for the latter is in its turn supported by the vesical wall. It is therefore impossible for it to be forced or become incompetent in the way one would be led to suppose from many statements in books and journals.

How, then, does back pressure reach the kidney? First let us look at the normal behaviour of the ureter. As a rule this tube is empty. Periodically a peristaltic wave passes along it, bringing urine which has collected in the kidney pelvis down to the bladder. The ureter is a very thin walled tube, its musculature being many times inferior to that of the bladder. In order to ensure the safe delivery of its contents into the filling bladder the ureter adopts shock tactics and shoots them into that viscus at a speed which carries them right across the cavity\* (consider the appearance seen at cystoscopy when indigo-carminé swirls into the bladder). When delivery is accomplished the valve is slammed back and the door is closed. The ureter is empty again until the process is repeated. But its power is limited, and as

\* The peristaltic wave of the ureter travels at the rate of about 20-30 mm. per second. (Lina Stern : *Thèse de Genève*, 1903.)

the bladder pressure rises there approaches a time when its force will prove inadequate and it will experience a rebuff. Some fluid will then be returned to the ureter, which will no longer be an empty tube. Eventually some of the urine will remain, elevating the valve like a foot in a door. Immediately this happens the superior power of the bladder will rush the entrance. A sortie of its contents will fill the ureter and the ureteric door will remain indefinitely ajar.

So far the bladder and ureter have been completely shut off from each other except during an efflux. There has been one-way traffic only. From now onwards, so long as the vesical retention is unrelieved, the two systems are thrown into one and have a common pressure in which, as in a tambour, pressures produced in one part are recorded also in the other. Hitherto the ureter has been empty, and both it and the kidney have been safeguarded from intravesical pressure. Now bladder pressure is exerted on the renal papillæ, causing atrophy, and on the renal parenchyma, which is caught between the tough capsule on the one hand and the distended pelvis on the other.

*What is the degree of pressure to which the kidney is subjected?*—We have just seen that whatever the intravesical pressure, the intrapelvic pressure will correspond. The bladder suffering from obstruction behaves not unlike the uterus during parturition. For a time it rests quietly and the pressure is relatively low. Periodically it bestirs itself in a renewed endeavour to void its contents. A wave of contraction comparable to a labour pain then sweeps over it. Like the labour pain, moreover, this wave oversteps the bladder centres and calls the abdominal muscles to its aid. Let it be realized that, equally with the remainder of the urinary channels, the kidney bears the brunt of this compression, delivered not only from the hypertrophied bladder musculature, but also with all the expulsive force of the powerful abdominal muscles. Little wonder

that the kidney suffers severely in many instances. Not infrequently a patient during such a spasm will complain of severe pain in the loin—a sure sign of the incompetency of the uretero-vesical valve and an indication that damage is being done to the kidney.

Bladders palpable above the pubes vary considerably in their tenseness; some are flaccid to the touch, others are firmer. The former are discovered in men who have suffered a gradually increasing distension, possibly without their knowledge, for a longish time. The latter are to be found in cases of acute or recent retention. As a rule the tension in the flaccid type will correspond to a column of urine about 25 to 30 cm. in height, whereas the tense bladders will show a column of about 40 cm. In practice these figures are frequently noted, because in one method of relief the patient's bladder is gradually emptied against the pressure of a column of his own urine. Both types require the greatest care in treatment if grave renal injury is to be avoided. It might be expected that the tense bladder would have caused more injury to the kidney than the more flaccid one, but in actual fact this does not follow, for the latter has been producing its nefarious effects on the kidney for a long time, whilst the former is probably of more recent date.

*Effects of pressure on the kidney.*—First consider the results of back pressure on the circulation of the kidney. Whilst under compression it is subjected to a pressure ischæmia which on release gives place to hyperæmia and œdema. The anæmia of the kidney is probably responsible for a part, perhaps an important part, of the uræmia so evident when some prostatics are first seen. Heidenhain showed that by clamping the renal artery for a few seconds the kidney was put out of action for a prolonged period. Simultaneously the renal cells are compressed between the distended pelvis and the firm capsule. It is difficult to assess the parts played respectively by vascular and cell compression.

It is, however, possible to speak with much more certainty about the effects of releasing that pressure from the kidney, for the ischæmia gives place immediately to engorgement if the release is quickly carried out. In some cases even when skilfully and properly executed the same results occur. The clinical picture is then one of the most striking and menacing in urological practice. Its pathological counterpart is renal hyperæmia associated with an effusion which may become hæmorrhagic in severe cases. Engorgement may manifest itself clinically in albuminuria, hæmaturia and possibly suppression, whilst the clinical and laboratory evidences of uræmia become more pronounced. To handle an obstructed patient in such a manner that renal engorgement is reduced to a minimum is the crux of successful treatment. The keynote is the slow evacuation of the bladder and the very gradual reduction of pressure. Yet in some measure the artificiality of the relief must be responsible, for when one observes a patient overcome his own obstruction by passing urine naturally there is much less likelihood of uræmic symptoms supervening in spite of the sudden drop in pressure. Into the causes for this I have not space to enter.

If the bladder is septic, or becomes septic from catheterization, infection will, when the two compartments become one in the way already described, have direct access to the kidney by the continuity of the urinary column and will be transmitted into the depths of the organ because of the dilatation of lymphatic and renal channels, to which attention will shortly be drawn. This sepsis may have been present prior to the onset of obstruction, but is very liable to arise when measures of relief are instituted.

I want to go on now to a sideline for a time in order to explain certain other events which take place in the obstructed kidney. Its relevance to the

present study will soon be evident.

In recent years it has become an almost universal practice when examining for renal disease to fill the kidney pelvis with some solution which is opaque to the X-rays and to radiograph it (pyelography). When this examination first came into favour occasional ill-effects, including a number of fatalities, resulted from faulty technique. At the necropsies the silver salts, which at that time were employed for pyelography, were discovered in the kidney substance, perirenal tissues, and in distant organs (lungs, liver, etc.) as emboli, and it became obvious that some mechanism existed by which intrapelvic contents could pass into the circulation.

Before the introduction of pyelography many observations had from time to time been made on the resorption capacity of the kidney, most of which had received little attention. Thus Ribbert (1883) injected the pelvis of one kidney with potassium ferrocyanide and recovered that substance from the urine excreted by the opposite kidney. Poirier (1891) experimentally showed the retrograde permeability of the kidney: First he injected fat under pressure into the pelvis of dogs and watched it pass into the renal vein and vena cava. He then reversed the process, introducing fat into the renal vein and recovered it in the pelvis. In another experiment he used water, which, when a certain level of intrapelvic pressure was reached, ran out from the renal vein. Since then numerous observers have repeated and confirmed these results, using all manner of materials for purposes of injection. The striking facts are: (1) that at a certain pressure level reflux from the kidney takes place into the general circulation (pyelo-venous reflux) and (2) that products regurgitating into the circulation of one kidney may be recovered in the urine of the opposite organ.

Recently the whole question has excited interest amongst urologists especially in its bearing on pyelo-

graphy, a procedure in which the conditions for a clinical repetition of the experiment constantly face the operator. But a moment's reflection shows that it must have at least an equal interest in cases of urinary obstruction, for if the pressure rises to the requisite level, regurgitation of pelvic contents into the circulation must inevitably ensue. The study of pyelography has thus thrown a sudden and unexpected light on the problems of urinary retention which we are at present considering. In prostatic disease, which I have particularly in mind, one or both ureters may be affected or one may be involved before the other, but in severe or late cases both must be regarded as involved—the obstruction is bilateral. For the moment, however, it will be convenient to consider the effects of occlusion of one ureter; when this occurs, either experimentally or by some pathological process, a definite train of events is set in motion. At first urine is passed into the empty pelvis and ureter and continues to be secreted until a certain tension is produced, when secretion stops. The point at which it stops is called "the secretory pressure." It is variable in different animals and in different circumstances, being dependent on many constantly changing factors of which the most important are the blood pressure and diuresis.\* Under general conditions the maximum secretory pressure lies about 40–60 mm. of mercury below that in the aorta.† Blood pressure and diuresis show many variations in elderly prostatics and the secretory pressure must vary within somewhat wide limits, but will on the whole tend to be definitely above the average for the human subject.

Experiments to show at what level reflux commences have been frequently made. Lindemann (1904) was

\* For full consideration see Cushny's "Secretion of Urine," p. 110 *et seq.*

† Again, "The maximum ureteral pressure is reached when the osmotic resistance of the fluid in the tubules balances the absorbing force." (Cushny.)

probably the first to undertake this test, and recently it has been repeated by Hinman and Lee Brown and others. Hinman estimated that a pressure of 20 mm. of mercury was necessary in a sheep's kidney to obtain slow permeation, but that with 30–40 mm. of Hg a rapid filling of the renal veins occurred. Once this flow has been established it could be maintained by a relatively low pressure. But all these pressures are obviously below the secretory pressure, and it might therefore be surmised that if the ureter were simply ligatured the kidney's own secretory pressure would provide sufficient tension to cause a reflux. That this is so was shown by Tuffier (1894); he placed in the ureter a very small bulk of strychnine solution and ligatured the tube. No effects were noticed until the secretory pressure produced a reflux, when the animal quickly died from strychnine poisoning. In a similar series of experiments undertaken by Hinman and Vecki, phenolsulphone-phthalein was imprisoned in the ureter. The contents of the ureters examined at various times thereafter showed that the dye gradually disappeared. It may therefore be accepted that when the kidney outlet is occluded excretion goes on until such an elevation of the intrapelvic pressure has occurred that conditions favouring a pyelo-venous reflux are established. The contents of a hydronephrosis are therefore not constant, there being an exchange continually in progress, the newly excreted urine displacing more and more of the original pelvic contents.

In a unilateral hydronephrosis, as shown in the experiment of Ribbert quoted above, the contents under compression in one renal pelvis were re-excreted by the opposite kidney. This experiment can be repeated during any cystoscopy in which double catheterization of the ureters has been carried out. Iodine salts introduced into one kidney for pyelography can within five minutes be demonstrated in the urine coming from the other side, showing that, even with the precautions

used in pyelography, the blood stream receives some of the injected solution.

So much for unilateral obstruction. But if the obstruction is of the lower urinary tract three additional factors come into play : (a) Both ureters are obstructed and there is therefore double the quantity of reflux; (b) There is no kidney available to re-excrete; (c) The secretory pressures, which unaided were responsible for the production of tension in unilateral obstruction, are augmented by the intravesical and intra-abdominal pressures as above described. From these conditions it follows that the toxæmia of bilateral obstruction much more than duplicates that caused by unilateral occlusion.

*The routes by which pelvic contents reach the circulations.*—Into this vexed problem it is unprofitable at the present to enter in any detail, but one or two facts must be mentioned. In different circumstances there is more than one route available. Injected fluids have been found in the urinary tubules, and in the renal lymphatics and interstitial tissues. But perhaps the most important and unexpected route is a direct traumatic one which produces a connection between the calyces and the veins. It is known that surrounding the calyces as a more or less complete ring (Traut) are large veins lying in close contact with the wall of the calyx. This contact becomes yet more intimate when the calyces bulge from over-distension. There is a weak point in the wall of the calyx where its free or unsupported part is reflected on to the papilla of the kidney (fornix calycis). At this point a comparatively trifling tension may cause a tear, and owing to the close proximity of the venous ring this tear is liable to extend directly into the vein. In experimental specimens multiple tears may be seen. In this variety of pelvic regurgitation therefore a direct communication between the pelvis and the venous system is established.

In another form regurgitation is stated by some



observers to pass first into the collecting tubules and from there into the circulation. In the human kidney tubular regurgitation is more easily produced than it is in the kidneys of some animals, *e.g.* the sheep (Lee Brown). It has been shown that in hydronephrosis reflux can be obtained at unusually low pressures, quite probably as a result of the existing dilatation of the tubules. If it is recalled that many prostatics' kidneys are already dilated from partial obstruction before complete retention occurs, it will be readily realized how vulnerable they are and how easily reflux into the circulation may be produced.

Healthy urine in the circulation is intensely toxic. The lower animals are killed by the introduction of about 6 c.cm. of human urine per kilo. of body weight. What its relative toxicity is for man I do not know, but it is certainly a very unwholesome addition to the circulation. In many cases the urine is septic and as such must pass directly into the venous stream. The importance of this to the health of the patient calls for no comment.

*Conclusion.*—I have sought to examine the processes leading up to incompetency of the ureteric valve and the sequelæ. Once the valve is incompetent it becomes necessary to form a mental picture of dilatation not only of the pelvis but also of the urinary canaliculi, to visualize pressure atrophy of the parenchyma, vascular compression and pyclo-nephritis. Regurgitation directly into the circulation, of water, urinary excreta and perhaps bacteria also occurs. A close inspection of these sequelæ does not conduce to complacency in the handling of such cases.

# Diathermy in Urinary Surgery

By ARTHUR JACOBS, F.R.F.P.S.

*Urologist to the Glasgow Royal Infirmary.*

UNDER the term "High Frequency" are included electrical actions of various types. These actions may be produced either with the active electrode in contact with or at a distance from the tissues and will vary accordingly. If an electrode is applied directly to the tissues or buried in them, two possibilities present themselves:—first, if the contact is made with a large electrode of about the size of the hand, there will occur the simple phenomenon of heating to about 50° F. or 60° F. This is medical diathermy and is without any operative interest. On the other hand, if the action is made on a limited area by means of a small-sized electrode a temperature of from 300° F. to 800° F. can be obtained and carbonization will occur. This is surgical diathermy or electro-coagulation. If a piece of tissue which has just been subjected to electro-coagulation be examined, two zones of destruction, differing in appearance, will be observed. In the centre there will be seen a black area of carbonization and immediately external to this a whitish zone of coagulated tissue. In addition, a third zone of secondary necrosis makes its appearance about twelve days later. If the application of high frequency is made from a distance, that is, if the electrode is not in contact with the tissues, the effect on the latter is produced by sparks which will project from the electrode through air or fluid. This form of high frequency is termed "Etincellage" or sparking, and with a suitable diathermy machine<sup>1</sup> can be produced by raising the voltage and lowering

the amperage of the current. Etincellage is more limited in its action and causes a lesser degree of destruction than electro-coagulation.

*New growths of the bladder.*—The most important use of high frequency in urinary surgery is in the treatment of vesical papillomata. About 90 per cent. of all bladder tumours are of epithelial origin, and simple papillomata are as frequent as all the other types put together. The condition must be looked upon with suspicion, for a neglected simple papilloma has a very definite tendency to become malignant. They occur most frequently between the ages of 40 and 50. Hæmaturia may be the only symptom; it is usually intermittent, spontaneous and painless in character and tends to occur at the end of micturition. Since even a single attack of hæmaturia indicates the possibility of a vesical tumour, a cystoscopic examination should be made on every patient exhibiting this symptom. By this means diagnosis is usually easy, though in delayed cases, with painful urination and profuse hæmaturia, cystoscopy may be painful and difficult as a result of vesical intolerance and cystitis. Two main types of papillomata are observed through the cystoscope. Both varieties may be single or multiple and are most frequently observed at the base of the bladder to the outer side of the ureteric orifice. They are also found on the lateral wall, on the dome and on the anterior wall, but never on the trigone. One type is the pedunculated papilloma, the branching villi of which can be observed waving about in the fluid which distends the bladder. These pedunculated tumours are usually benign. The other main type is the sessile papilloma, which varies in appearance from tiny velvet objects to large masses almost filling the bladder. These sessile tumours show a marked tendency to infiltrate the bladder wall and become malignant. Between these two types many

variations may be observed.

There is no longer any controversy regarding the treatment of election of simple tumours of the bladder. It is by high frequency through the natural passages and under cystoscopic view. The materials necessary for this treatment, in addition to a high frequency machine controllable by a foot-switch, are a single catheter cystoscope and a supple electrode. Frank Kidd<sup>2</sup> has devised a cystoscope the terminal end of which is used as the electrode. The necessity for anæsthesia depends a great deal on the temperament of both the patient and operator. I am in favour of caudal or spinal anæsthesia. One or more treatments may be necessary, lasting from a few minutes to as long as an hour. If the papilloma is of the pedunculated type it is destroyed by electro-coagulation, that is, the electrode is placed in contact with the tumour and is connected to the high intensity current of the apparatus. When the base of the papilloma is reached, the less destructive etincelage or sparking is substituted for electro-coagulation. In treating sessile papillomata electro-coagulation should be used throughout; repeated applications are made until the tumour is about a quarter of the original size. It is to be remembered that destruction after high frequency continues for weeks after the end of the operating act. A catheter should be tied into the urethra for 48 hours after treatment and the bladder irrigated several times during that period with a weak nitrate of silver solution. The destroyed portions of the tumour are thus washed away. After the sittings are completed, cystoscopic examinations of the bladder should be made every one to three months for a year and at intervals of six months during the following year. Should relapses occur, they are treated in the same manner as the original tumour.

When a growth is situated at the apex or near

the internal meatus of the bladder, it may be impossible to guide the electrode into contact with it. In this event a suprapubic cystostomy must be performed and the tumour treated by high frequency through the open bladder. By using a retrograde operating cystoscope such as that of Swift Joly,<sup>3</sup> however, the necessity of opening the bladder in order to reach growths situated in these regions will in most cases be obviated.

Unfortunately, high frequency is not indicated for malignant growths of the bladder, for it appears to have no curative effect. If, however, the situation or the extent of the growth negatives a partial cystectomy, the condition of the patient may be ameliorated by diathermy, which reduces or completely stops hæmorrhage and retards the rate of spread.

*The prostate.*—Prostatic obstruction due to "middle lobe" enlargement or "prostatic bar" is effectively treated by electro-coagulation. Probably, several different pathological changes play a part in the etiology of this condition. Increase of fibrous tissues following on previous attacks of inflammation of the prostate, increase of glandular tissue in the bladder neck, and localized enlargement of the prostatic gland are the causes variously described for this form of prostatism. Clinically, it is recognized by symptoms of prostatic obstruction occurring in a patient usually under sixty, who, on rectal examination, shows no evidence of prostatic enlargement. A definite diagnosis is only possible after cysto-urethroscopic examination, which reveals a thickening of the posterior segment of the bladder neck.

If in these cases the bladder is opened, a small fibrous gland is found, which can usually only be removed by open dissection. When skilfully performed satisfactory results may be obtained by this procedure. Not infrequently, however, following on

an attempt to remove the prostate by the usual digital method of enucleation, a haphazard piecemeal removal results which fails to relieve the patient of his obstruction. The per-urethral operation,<sup>4</sup> by which the obstruction is destroyed by electro-coagulation, avoids these difficulties and is a procedure in which the mortality is practically nil. The technique is similar to that used for the treatment of vesical papilloma. Instead of the cystoscope, however, a cysto-urethroscope is employed, and continuous irrigation of the bladder must be kept up throughout the seance.

*Cystitis.*—Cases of simple chronic cystitis which have resisted the classical treatment of bladder lavage and instillations give excellent results when treated per urethra by etincellage or sparking. This form of treatment is especially beneficial in inflammatory lesions of the bladder neck, a condition more common in women than in men. Polyuria, pain and other signs of cystitis may be inexplicable until a thorough examination of the crest, the urethral and the vesical aspects of the bladder neck reveals an area of chronic inflammation, sometimes so marked as to resemble a leukoplakia.

*Tuberculosis of the bladder.*—It is not an uncommon experience to find tuberculous ulceration of the bladder persisting for months after the removal of the kidney which has caused the bladder infection. Instillations into the bladder of such preparations as gomenol oil or methylene blue usually improve the condition, but may fail, however, to banish this rebellious type of ulcer. In that event, etincellage of the ulcer and of the neighbouring mucosa affected with cystitis frequently gives excellent results. In addition, a thin electrode may be passed up the ureter on the affected side and the mucosal lining destroyed. High frequency of tuberculous bladders is usually very painful, and some form of anæsthesia

is therefore essential.

*Impacted calculi in vesical end of ureter.* — A stone may become incarcerated in the vesical end of the ureter as a result of stricture or of extensive oedema around it. In the former case the orifice can be enlarged and the stone released by burning through the mucous membrane at a point over the impacted calculus.<sup>5</sup> When extensive oedema is the cause of the obstruction, sparking over the affected area will reduce the swelling, following on which the stone may be passed spontaneously.

### Bibliography

<sup>1</sup> Heitz-Beyer: "Appareil médico-chirurgical de haute fréquence," *Bulletin officiel de la Société d'électro-thérapie et de radiologie*, April, 1923.

<sup>2</sup> Kidd, Frank: *Lancet*, 1925, ii, 1282.

<sup>3</sup> Joly, Swift: *Lancet*, 1922, i, 1251.

<sup>4</sup> Walker, Kenneth: *Brit. Med. Journ.*, 1925, i, 201.

<sup>5</sup> Young: "Practice of Urology," vol. i, p. 404.

# Ludwig's Angina

By HAMILTON BAILEY, F.R.C.S.

*Surgeon to the Royal Northern Hospital.*

IN 1836, Wilhelm von Ludwig, a physician of Stuttgart, contributed to his local medical journal an account of five examples of what is now known universally as Ludwig's angina. At that time the possibilities of surgical drainage were not appreciated, and three out of these five cases succumbed. Ludwig described a clinical entity characterized by a brawny swelling of the submaxillary region combined with inflammatory œdema of the mouth. It is the *combined*



FIG. 1.—Ludwig's angina. The brawny swelling beneath the jaw and the œdema of the floor of the mouth (which can be seen in the photograph) are characteristic features of the condition.

cervical and intrabuccal signs which constitute the characteristic feature of the condition (Fig. 1). To quote Ashurst: "It may begin in either situation, but until it spreads from the submaxillary tissues



to the sublingual tissues, or in the reverse direction from the sublingual tissues to the submaxillary region, it does not constitute Ludwig's angina."

#### ORIGIN OF THE INFECTION

Ludwig showed that the essential pathology of the condition was infection of the cellular tissues about the submaxillary salivary gland. Infection of this space may occur in several ways:—

*From an alveolar abscess.*—Contrary to what we might expect, it is an abscess connected with the last lower molar which is prone to infect this periglandular space, for the following reason. Alveolar abscesses commonly point on the labial side of the mandible, for the outer alveolus is the thinner. In the region of the wisdom tooth, however, it is the inner alveolus which is weaker; consequently, if an abscess connected with the last molar breaks its confines it is more liable to burst through the inner side of the jaw.

*From an inflamed submaxillary salivary gland.*—Most authorities state that infection by this route is infrequent, or that it does not occur. It happens that in two out of five examples of Ludwig's angina which have been under my observation the patient has had a stone in Wharton's duct. Details of these cases were published in THE PRACTITIONER.

*From lymphangitis.*—Although the main lymphatic glands of the submaxillary triangle are superficial to the fascial space in question, doubtless infection can be conveyed thither by the abundant lymphatic vessels around the salivary gland, a boil on the chin being a common primary focus.

#### COURSE OF THE DISEASE

Unless tension is relieved certain cases rapidly assume a grave aspect. The swollen tongue is pushed towards the palate and forwards through the open mouth, while the cervical cellulitis extends down the

neck in that most dangerous plane—deep to the deep fascia. Only too often, within 12 to 24 hours the patient's life is threatened or taken. At necropsy upon a man of 42 who died of Ludwig's angina soon after admission to the Liverpool Royal Infirmary, Bickersteth found "nothing abnormal superficial to the deep cervical fascia, but beneath that structure a diffuse cellulitis. All muscular interstices and the connective tissue surrounding the trachea were infiltrated with sero-purulent fluid extending upwards to the root of the tongue and downwards to the anterior mediastinum." Cultures show that in about 70 per cent. of cases the infecting organism is a streptococcus.

#### PECULIAR DANGERS OF LUDWIG'S ANGINA

I am strongly of the opinion that in early stages of *subcutaneous* cellulitis it is better to withhold the knife. In Ludwig's angina the position is entirely different. Here we are confronted with infection of a fascial space walled in on all sides by dense fasciæ and muscles, a space where clinical experience and experimental injection demonstrate that inflammatory exudate can, and does, pass via the tunnel occupied by the stylohyoid to the submucosa of the glottis.

The integument allows inflamed subcutaneous tissue to swell; the cervical fascia is unyielding, and in this respect may be compared to periosteum. Obviously, therefore, if it is logical to decompress immediately the infected area in osteomyelitis it must be doubly so in Ludwig's angina, for in the latter condition there are all the dangers of impending septicæmia combined with a possibility of early œdema of the glottis.

#### OPERATIVE TREATMENT

The objective is a communication between the fascial space and the exterior. Early in the disease this can be easily, and often effectively, accomplished

in the following way. A deep, really deep, incision is made along the middle two thirds of a line joining the symphysis menti with the centre of the hyoid bone (Fig. 2). A hæmostat is inserted and thrust upwards until its blades protrude almost beneath the sublingual mucosa. If the disease is limited to one submaxillary triangle the beak of the forceps is directed towards the submaxillary salivary gland of that side. When it is judged that the fascial space has been entered the blades are opened. A drainage tube is passed into the incision and copious dressings soaked in hot



FIG. 2.—Ludwig's angina. A deep incision in the position indicated, passing almost to the sublingual mucosa, proved effective in this comparatively early case.

magnesium sulphate solution applied. General treatment follows the usual lines for a severe streptococcal infection.

While operative measures as outlined above, if carried out early, are often satisfactory, it is probable that more thorough decompression of the space would reduce the total mortality of the condition, which at the present time is about 30 per cent. More elaborate decompression is imperative when simple incision fails to give relief, and it was this circumstance that led Leonardo to make a wide transverse incision dividing

the mylohyoid and geniohyoid muscles. Later, van Wagener and Costello found that primary division of the cervical diaphragm was attended by excellent results, and these authors advocate division of the mylohyoid as a standard measure for established Ludwig's angina. I adopted their suggestion and in a fulminating case in a woman of 70 obtained an encouraging result. The technique is as follows: A wide incision is made at the base of the submaxillary triangle following the lower border of the jaw (Fig. 3). The facial artery is identified and divided between



FIG. 3.—Incision for compressing thoroughly the space beneath the mylohyoid muscle.

ligatures. The submaxillary gland is retracted and the mylohyoid muscle divided completely. Often pus will be found under the mylohyoid muscle around the deep prolongation of the submaxillary gland. It may be necessary to carry the incision right across to the other side, and where œdema is extreme to convert the transverse incision into a T by a mid-line prolongation to the hyoid.

#### SPECIAL CAUTIONS

- (1) *Anæsthesia*.—Nitrous oxide gas should be

avoided. As pointed out at a coroner's inquest upon a case of Ludwig's angina, gas is a "spasmodic" anæsthetic. A certain degree of local anæsthesia is possible by blocking the cervical nerves behind the posterior border of the upper third of the sternomastoid. Such local anæsthesia reduces considerably the amount of general anæsthesia required.

(2) *Tracheotomy instruments*.—These should always be at hand until the acute inflammation has definitely subsided. Tracheotomy may become necessary, but if the area has been thoroughly decompressed it should not be undertaken unless there are definite signs of commencing asphyxia. With the tongue pushed up to the roof of the mouth the patient experiences a feeling of impending suffocation, but reassurance, ice to the tongue, and the inhalation of some oxygen has, in the cases which I have seen, proved effective.

### References

- Ashurst, A. P. C. : *Arch. Surg.*, 1929, xviii, 2047.  
Bailey, Hamilton : *THE PRACTITIONER*, 1931, cxxvi, 671.  
Bickersteth : *Liverpool M. and S. Reports*, 1869.  
Leonardo, R. A. : *Ann. Surg.*, 1927, lxxxvi, 636.  
Van Wagener, W. P., and Costello, C. V. : *Ibid.*, 1928, lxxvii, 684.

# The Diagnosis and Treatment of Coronary Thrombosis

By G. S. HAYNES, M.D., M.R.C.P.

*Senior Physician to Addenbrooke's Hospital, Cambridge.*

ONLY during the past few years has it become evident that coronary thrombosis gives rise to a definite syndrome of signs and symptoms which may be readily recognized clinically. It appears that the condition is seen more frequently in private than in hospital practice, and it may be that the incidence is increasing. According to Willius it is probable that acute coronary obstruction is on the increase in America, although diagnosis is becoming more and more accurate. Carey Coombes says he tentatively diagnosed cardiac infarction once before the war; since the war he has diagnosed it in many instances.

Apparently there is no one specific disease that may be said to precede or cause coronary sclerosis and thrombosis. The common infectious diseases, foci of infection or acute infections do not play a part in causation. Levine says that diabetes has an intimate relation to arterial disease and to the development of coronary sclerosis. 23·7 per cent. of his 145 cases were glycosuric. He believes that diabetes has no causative influence in the disease but merely indicates the type of person who has a vulnerable vascular system. Syphilis is not a common cause; 4·5 per cent. of eighty-nine cases gave a positive Wassermann reaction. It is generally true that coronary thrombosis is the end result of previous angina pectoris in some or other degree. In many cases where the attack seems to have been the first indication of any existing heart disease, close questioning may elicit the

fact that for some months or even years there has been definite constriction in the chest on hurrying or some other significant complaint. On the other hand some have apparently been in perfectly normal health in every way until the catastrophe occurred. It is probable that a previously existing hypertension is a factor in the majority of cases, but it is clear from reported cases that a high blood-pressure is not essential. Some cases show evidence of sclerosis in the radial, brachial, temporal and retinal arteries, but there are many in which little or no signs of arterial disease can be found.

The condition is found much more commonly in males than in females. Parkinson and Bedford report ninety-three males and seven females in a series of 100 cases. Willius in America gives the proportion as  $4\frac{1}{2}$ -1. Men as a group have been subjected to greater stress and strain than women; it may be that with the equality of the sexes the proportion will be reduced. Cases occur between the ages of 40 and 70, with the maximum age incidence about 60 years. The onset is usually sudden and may be the first indication of heart disease, or there may be a history of preceding painful heart attack, dyspnœa on exertion, or attacks of shortness of breath. The attack as a rule has no relation to exertion or to a meal, and frequently occurs when the patient is at rest, even when in bed at night. One of three things may happen—sudden death, intense pain, or urgent dyspnœa.

The group of patients in whom death occurs instantly, or in a very short time, is comparatively of less clinical interest than that in which the immediate result is not fatal. These cases frequently become problems for the coroner, who has long been familiar with coronary disease as a cause of sudden death. In some cases the lumen of the main channel is patent, and there is no gross macroscopic ventricular disease. In others the channel has become obstructed more or less completely

by a mixture of softened and calcified material, the final complete obstruction by a thrombus bringing the co-ordinated activity of the muscle to an end. Probably in all these cases fibrillation of the ventricle is set up, and the circulation thereupon comes to a standstill. Ventricular fibrillation follows ligation of the coronary arteries, and has been found in some cases in which electro-cardiograms of the dying heart have been recorded.

If death is not instantaneous we may learn that the patient was seized with a pain of agonizing severity, more intense than anything in his experience. In most cases the site of the pain is in the region of the sternum, often towards the lower end, and occasionally in the upper abdomen. The pain is constricting in character and may radiate to the neck, throat, shoulders, back, or arms, more often to the left than to the right.

The attack may cause collapse and loss of consciousness; more frequently the patient complains of extreme weakness, or he may writhe in agony or even walk about and try various changes of position. This is in marked contrast to the behaviour of a patient in an attack of angina pectoris, in which he usually keeps as still as possible.

The pain is usually persistent and may last hours, or even several days. After the extreme severity has been eased by morphine a dull ache usually remains for some days. Nausea and vomiting are common. Levine writes: "There frequently is vomiting at the onset of the attack, and it is this feature and the general feeling of distress that make the patient, the family, and the physician believe that the attack is one of acute indigestion, a term that should be given up entirely in medical nomenclature, especially when it ends fatally, for then it practically always is incorrectly used to describe an attack of coronary thrombosis." There is usually a condition of shock; the patient becomes cold and pale, with sweating and an ashen-grey



colour. The pulse will be found to be small and rapid, or impalpable, and the blood-pressure quickly falls, to about 100 if it has been previously normal, and 25 or 30 per cent. of the original amount in those who have had a high blood-pressure. The rise in pulse-rate and fall in blood-pressure are in marked contrast to what obtains in angina, where the pulse-rate remains unchanged and the blood-pressure, if it alters, rises. Dyspnoea occurs in almost all cases to some extent, and, especially in cases with pre-existing signs and symptoms of heart failure, may be the most striking and important feature, overshadowing the pain, which may, indeed, be absent altogether.

On examination the heart-beat will be found to be so weak that as a rule no impulse is visible or palpable; the sounds are faint; there may be a systolic murmur; the rhythm is at first regular, though after the onset of the attack almost any type of irregularity may come and go. The most important point is the quality of the heart-sounds, which are always muffled or distant, and may even be inaudible. A gallop rhythm, due to reduplication of the first sound, is apt to occur, and extrasystoles are not uncommon. In fact, almost any form of cardiac irregularity may be found. These are apt to be transient, and a careful watch should be kept for alteration of rhythm, as for pericardial friction. Any degree of auricular-ventricular conduction disturbance may be found during the early days following an attack, and partial or complete heart-block occurs. Other fairly common disturbances are auricular fibrillation and ventricular tachycardia; I have seen a patient develop paroxysmal fibrillation during the course of this complaint. Often within a few hours of the attack there will be a slight rise of temperature; it is usually about 100°, lasts from one to several days, and gradually subsides. Leucocytosis generally occurs very soon after the onset, the count usually showing 12,000 to 15,000 cells, and lasts as long as the fever

does. Infarcted tissue anywhere in the body probably liberates toxic products producing leucocytosis and fever.

In some cases, after an interval of a few hours to several days after the onset, a pericardial friction rub develops. When present, this is heard over the lower part of the præcordium between the nipple line and the sternum. In rheumatic pericarditis the rub is usually first heard at the base, in the third left space close to the sternum. This sign does not occur in the majority of cases; it was present in 13·8 per cent. of Levine's 145 cases and in 7 per cent. of Parkinson and Bedford's cases. Pericarditis was found post mortem in 50 per cent. of the former and 13 per cent. of 83 examinations by the latter observers. Pericardial effusion is very rare and was only noted once by each of the authors quoted, that is to say, twice in 245 cases. The development of this type of pericarditis is clear. After the coronary vessel is occluded, the heart muscle which was supplied by that artery becomes infarcted. If the process of infarction is so extensive or so situated that it extends sufficiently to the surface to involve the visceral pericardium, local inflammation and irritation develop at the injured site. The infrequency of pericarditis is due to the fact that the infarction usually involves the endocardium, and is often separated from the pericardium by a layer of muscle which derives its blood supply from the epicardial vascular network. If the process involves the posterior or diaphragmatic portion of the heart no friction will be heard. However, when present, pericardial friction is a most valuable diagnostic sign.

Signs of venous engorgement may appear soon; the bases of the lungs often show the fine crepitations of oedema, and the liver may become enlarged and tender early.

In doubtful cases the aid of the electrocardiogram should be invoked, when certain changes due to infarcted muscle may be seen in the ventricular

complex, and may give a definite indication of occlusion of a coronary artery.

If the patient survives the initial phases of the attack he is likely to live some time. Of Parkinson's 100 cases, 31 died, the average duration of life being six months. These figures do not include those dying at the very onset of the attack, and he says that he can confidently assert that those patients seen alive with coronary thrombosis are more likely to survive than to succumb. It is obvious that all degrees of infarction occur and that all grades of coronary disease may be present along with it, so that clinical results must vary considerably. Some patients are able eventually to lead ordinary active lives; others are able to get about in comfort, though their lives are restricted, while some are crippled by pain or heart failure. Especially in those cases in which previous cardiac symptoms have been slight or absent a hopeful prognosis is often justified, and even those in grave peril for days may recover and enjoy fair comfort for a time.

Those who survive the initial attack may die suddenly with a recurrence of pain a few days later, or after freedom from symptoms for some weeks may be seized in the night with severe fatal angina. Others may become increasingly breathless and cyanosed and die of congestive heart failure in a few days or weeks, or they may eventually recover even from this condition. On the other hand, certain patients recover from the initial shock and collapse with remarkable rapidity, and shortly after the attack may present no abnormal physical signs.

As a rule convalescence is slow. The heart's action gradually becomes stronger, the sounds become louder, and the patient's colour returns. The blood-pressure rises, but frequently does not reach the high level which may have been observed before the attack. Tachycardia may persist for weeks; in a case I had the opportunity of observing the pulse-rate and the

systolic blood-pressure gave approximately the same figure, 110, for two months. During the first few weeks after the onset of the attack, watch must be kept for signs of embolism from intracardiac thromboses, such as pain over the spleen, hæmoptysis, hæmaturia, paresis, hemiplegia or aphasia; or acute abdominal pain with distention; or pain in a limb with absence of peripheral pulse.

*Differential diagnosis.*—Cardiac infarction must be distinguished from other causes of dyspnoea and substernal pain, and also from acute abdominal conditions. Lesions of the aorta, such as acute aortitis and valvular disease, may give rise to acute exacerbations of pain about the manubrium sterni, but here the quality of the heart sounds should suffice to differentiate the condition from coronary thrombosis.

Aortic aneurysm sometimes causes severe substernal pain and paroxysmal dyspnoea, so that during the actual attack diagnosis may be difficult.

The onset of pericarditis may be sudden, with præcordial pain and rigor.

With regard to the præcordial pain known as pseudo-angina, we may distinguish that which occurs chiefly in women and is never fatal, and the toxic anginas due to tobacco, tea or influenza. Of the former condition, Sir Clifford Allbutt wrote: "It is levity to confuse the squalls of unstable 'neurotics'—mostly women—with the assault of one of the fiercest and most searching afflictions which can fall upon steadfast and resolute men." And again, differentiating such attacks from true angina, he writes: "The pain is different, the pulse is different, the panting is different, the behaviour is different, the storm is different, the duration is different, the causes are different, the issue is different." Sir Clifford described attacks of "angina minor" associated with hyperpiesia which may or may not pass on to the major form. The differential diagnosis of coronary thrombosis from angina pectoris can be

made on the points shown in the table taken from Parkinson and Bedford's original description.

#### DIFFERENTIAL DIAGNOSIS

	Angina Pectoris.	Cardiac Infarction.
Onset - -	During exertion -	Often during rest or sleep.
Site of pain -	Substernal - -	Substernal.
Attitude - -	Immobile - -	Restive; may walk about.
Duration - -	Minutes - - -	Hours or days.
Shock - -	Absent - - -	Present.
Dyspnœa - -	Absent - - -	Usually severe.
Vomiting - -	Rare - - -	Common.
Sweating - -	Slight - - -	Profuse.
Pulse - -	Unchanged - -	Feeble; often rapid.
Temperature -	Unchanged - -	Fever afterwards.
Blood-pressure -	Unchanged or raised	Lowered.
Congestive failure	Absent. - - -	Often follows.
Heart sounds -	Unchanged - -	Gallop rhythm or pericardial friction may appear.
Leucocytosis -	Absent - - -	May be present.
Electrocardiogram	May be abnormal -	Often diagnostic changes.
Action of nitrites	Often give relief -	Give no relief.

This condition must be distinguished from acute abdominal disturbance in those cases in which the pain is referred to the upper abdomen.

A patient with coronary thrombosis may have sudden excruciating pain in the upper abdomen, with marked rigidity and tenderness, nausea, vomiting, fever and leucocytosis, and the condition may suggest gall-stone colic, perforation of an ulcer, acute pancreatitis, acute appendicitis, or acute intestinal obstruction. Here are the notes of such a case seen in 1916 by Levine.

A male, aged 39, had been subject to anginal attacks for one year and was seized with a sudden pain in the epigastrium, radiating to the nipples. He had cough with blood-streaked mucus, and vomiting. Pulse rate 150; respirations 34. He was rather stuporous and cyanotic. Heart: apex not felt, sounds distant and weak. Many

## CORONARY THROMBOSIS

moist rales over left lower lobe. Tender indefinite mass extending from right costal margin to umbilicus. Slight jaundice. Upper abdomen very rigid. Patient seemed to be in extreme shock. Temperature 102°. Leucocytosis 21,400. B.P. 92/80. He was thought to have an acute surgical condition and was anaesthetized, the differential diagnosis being acute pancreatitis, gall-bladder disease or perforated ulcer. He died on the table. On post-mortem examination there was an extensive infarct of the left ventricle, large mural thrombus; descending branch of the left coronary almost obliterated. Nothing of importance in the abdomen except marked congestion of the liver.

Pain in the chest, dyspnoea, cough, rales at the bases, fever and leucocytosis might suggest pneumonia, but the location of the pain, character of the breathing and action of the heart would help in making the diagnosis.

The possibility that a hemiplegia might be due to an embolus from a left ventricular mural thrombus should always be borne in mind when it occurs in a patient with low blood-pressure. It occasionally happens that the early stages of an acute infarction are mild and disregarded, and embolism may suggest the condition.

*Treatment.*—As soon as possible after the onset of an attack of coronary thrombosis morphine must be given freely, in doses of  $\frac{1}{4}$ – $\frac{1}{2}$  grain subcutaneously or intravenously, repeated as often as is necessary to relieve the pain. It is essential and there are no contraindications to its use. The vasodilators, such as amyl nitrite and trinitrin, are useless, in contradistinction to true angina, and as they induce tachycardia and lower the blood-pressure, they are to be avoided. An attempt should be made to induce absolute physical and mental rest, and after the acute phase has passed it is desirable to keep the patient in bed for at least four weeks, and preferably six. During this time the infarct will heal and fibrose, and the risk of embolism from mural thrombi will become less and less. Digitalis should always be given in an endeavour to reduce the heart-rate and to avoid the onset of heart failure. It should be given in full doses at first, 20 minims every

four hours up to two drachms, and subsequently 15 minims every six hours, but care must be taken to avoid the production of any toxic symptoms. Later it is well to give theobromine sodium salicylate or diuretin in doses of 15 grains thrice daily. As I was able to show in a paper published in 1907, in collaboration with Prof. Dixon, this drug dilates the coronary vessels and increases the force of the systole. Milder persistent attacks of substernal pain may be treated by a combination of theobromine with luminal, as in the preparations theominal and theogardenal. In syphilitic cases treatment by arsenobenzol preparations should be given, combined with potassium iodide. In such a case where pain was very obtrusive, relief was afforded by the inhalation of a drachm of chloroform. Small meals only must be taken, and a valuable addition to the dietary is an ounce of medicinal dextrose daily in lemonade.

Subsequently during a further period of six weeks a gradual return to a suitable occupation may be advised. The limitations of movement, exercise, and mental excitement, set by the appearance of pain or dyspnoea, must be strictly observed, and the daily life ordered accordingly.

### Bibliography.

- Allan, G. A. : *Brit. Med. Journ.* 1928, ii, 232.  
 Allbutt, C. : " Diseases of the Arteries," 1915, vol. ii, 221.  
 Bramwell, J. C. : *Brit. Med. Journ.*, 1930, i, 681.  
 East and Bain : " Recent Advances in Cardiology," 1929.  
 Gibson, A. G. : *Lancet*, 1925, ii, 1270.  
 Haynes, G. S. : " Some Considerations in the Use of Cardiac Tonics. *Folia Therapeutica*," 1907.  
 Jones, E. Wyn : *THE PRACTITIONER*, 1930, cxxv, 370.  
 Levine, Samuel A. : " Coronary Thrombosis : Its Various Clinical Features," *Medical Monographs*, vol. xvi.  
 Mackenzie, J. : " Oxford Medicine," vol. ii, chap. xiii.  
 McNee, J. W. : " The Clinical Syndrome of Thrombosis of the Coronary Arteries," *Quart. Journ. Med.*, Oxford, 1925-26, xix, 44.  
 Norris and Landis : " Diseases of the Chest," Third Edition, 1924.  
 Parkinson, J., and Bedford, D. E. : *Lancet*, 1928, i, 4.  
 Parsons-Smith, B. : *THE PRACTITIONER*, 1930, cxxv, 353.  
*Proc. Roy. Soc. Med.*, xxi, 5 : " Discussion on Cardiac Infarction."

# A Contribution to the Study of Intestinal Infection

By J. STAVELY DICK, M.B., B.CH.

*Honorary Clinical Pathologist to the Manchester and Salford Skin  
Hospital.*

ONE of the incentives to embarking upon the work which it is proposed briefly to outline here was a not unnatural repugnance to preparing autogenous vaccines from specimens of fæces without obtaining presumptive evidence that there was an intestinal infection. The method of investigation adopted was largely determined by the apparent success of vaccine-therapy in a case referred to elsewhere.<sup>1</sup>

The enormous number and variety of microbes in the human intestine make the possibilities of evil at first sight seem appalling—so appalling, indeed, that, from this standpoint, one might almost condone the enterprise of the surgeon who, contemptuous of half measures, creates a new record by excising the intestinal tract *in toto*! On the other hand, Cruickshank<sup>2</sup> reassuringly points out that the intestinal mucosa has peculiarly selective absorptive powers and that our apprehensions are largely imaginary. This is obviously true, as so many people are alive and, as a matter of fact, continue to live to a good old age. A cursory reader of Cruickshank's instructive paper may, however, be lulled into a sense of security greater than the facts justify. A child, for example, is fed on milk from a tuberculous cow and later develops hip-joint disease. How did the tubercle bacilli find their way to such a joint? The presumption is, I think, that the barrier to infection interposed by the intestinal



mucosa was not in this case an efficient safeguard against bacterial invasion of the lymph or blood-stream. Green and Mellanby<sup>3</sup> have demonstrated that, in certain laboratory animals, infection or, as the case may be, non-infection is contingent upon appropriate nutrition of the animals in question. These very interesting experiments appear to support the clinical impression that intestinal infection plays an important part in various chronic ailments.

With these considerations in view, I have for over three years been endeavouring to obtain some presumptive evidence of intestinal infection, or its absence, in over a hundred patients suffering either (a) from various chronic skin lesions, or (b) from some type of chronic "rheumatism." The method employed involves only routine bacteriological methods. The results, therefore, are not open to criticism on the ground of difficulty of technique and "the personal equation," and may be put forward as facts which can be easily verified.

The utility of the method is based upon the assumption that comparatively feeble bactericidal power of a patient's blood affords presumptive evidence of considerable weight that infection is present, when other circumstances point to such a conclusion; but if evidence of comparatively efficient bactericidal power is obtained, this would appear definitely to exclude infection in face of merely theoretical or speculative opinions to the contrary.

#### DETAILS OF THE METHOD

The main difficulty at the outset was to find the quantity of a patient's faecal material which, when introduced into a given quantity of his own blood, would prove suitable for differentiating one patient from another as regards bactericidal efficiency. If an excess of faecal material is added, all bloods tend to yield positive cultures; if too little is added, too many

negatives will result. In practice I have found the following procedure the most convenient :—

A gram of the patient's liquid fæces is emulsified in 100 c.cm. of sterile water; 1 c.cm. of this emulsion is added to another 100 c.cm. of sterile water; 1 c.cm. of this diluted emulsion is further diluted with 3 c.cm. of a 1·5 per cent. sterile saline solution. In this way the working fæcal emulsion is obtained. Considerable preliminary work was required to ascertain the fact that a measurable quantity of this dilution of liquid fæces would, with 2 c.cm. of blood, permit of some estimate of comparative bactericidal efficiency.

Five sterile test tubes, which are numbered 1 to 5, and three reagents are required in the test as hitherto evolved. The reagents are the patient's fæcal emulsion, the patient's blood, and a sterile solution of sodium citrate (1·5 per cent.) and sodium chloride (1 per cent.). If for convenience these reagents are designated FE, B, and S, the final arrangement of the test may be exhibited at a glance :—

Test Tubes.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Add (1)	0.1 c.cm. FE	0.1 c.cm. FE	0.3 c.cm. FE	0.9 c.cm. FE	0.0 c.cm. FE
Add (2)	—	—	—	3 c.cm. S	3 c.cm. S
Add (3)	2 c.cm. B	2 c.cm. B	2 c.cm. B	2 c.cm. B	2 c.cm. B

The tubes are at once well shaken before clotting occurs and transferred to the incubator for 24 to 36 hours. At the end of this time 0·1 c.cm. of serum is taken from each of the tubes numbered 1 to 3 and distributed over agar slopes. These subcultures are then incubated for 24 to 48 hours and the results noted. (I may say, however, that tube No. 2 was only added six months ago. It and the subculture from it are incubated under comparatively anaerobic conditions. The numbers dealt with are therefore too few to permit of a useful survey and are consequently excluded from the purview of this paper. The function of each of the other tubes will be obvious.)

The results may be indicated in tabular form as

follows :—

	No. 1.	No. 3.	No. 4.	No. 5.
Sterile . . . . .	34%	15%	—	—
Gram-positive cocci only . . . . .	31%	—	—	—
Gram-negative bacilli only . . . . .	13%	—	—	—
Gram-negative bacilli and Gram-positive cocci.	16%	—	Hæmolysis 7%	0
Gram-negative bacilli and Gram-positive bacilli.	6%	—	Coagulation 9%	0

When the subcultures consisted of Gram-positive cocci only, the colonies had the naked-eye appearance of staphylococcal colonies. Indeed, a very surprising result has been failure to find streptococci in the subcultures in any case so far investigated. No doubt enterococci (diplococci) were sometimes present among the staphylococci, but they were not recognizable in the films. It may be added that streptococci (long or short chains) were especially looked for in several cases in which films from the fæces showed streptococci in considerable numbers and in comparatively long chains. One would infer that streptococci observed in faecal films have sometimes been credited incorrectly with pathogenic achievements. Or, on the other hand, these streptococci may have been relevantly pathogenic but anaerobic. Considerations of this kind led, as has been mentioned, to the addition of No. 2 tube and explain its necessity. The importance of this aspect of intestinal infection is accentuated by Colebrook's<sup>4</sup> recent observations in connection with puerperal fever. It was rather surprising to find hæmolysis in the presence of intestinal toxins so rare, if one takes 48 hours as the time limit for its production. Coagulation was, in all but one instance, coincident with an apparently pure growth of staphylococci in No. 1 tube. In these cases pruritus was a prominent clinical feature.

Without going into details at any length, a few points of interest may be mentioned. Staphylococci were present in the skin lesions of all patients whose No. 1 tube yielded an apparently pure culture of staphylococci. In a very intractable case of erythema

with recurring febrile attacks the subculture from No. 1 tube showed a Gram-positive coccus and a Gram-negative bacillus; a culture from this patient's urine also yielded a coccus and a bacillus which morphologically and in their staining reactions were indistinguishable from those in the subculture. The cases in which an apparently pure culture of Gram-negative bacilli in No. 1 tube was found might all be included in the group described as erythema multiforme; and one of these—a case of erythema iris—seemed to be influenced very favourably by an autogenous vaccine prepared from the subculture. With regard to the cases of chronic "rheumatism" dealt with, several of the patients suffering from infective arthritis responded in a very gratifying way to treatment by autogenous vaccines prepared from the subcultures, but the cases of clinical rheumatoid arthritis were disappointing. As an illustration of the former group, one case may be cited briefly:—

A girl, aged 15, had a severe attack of rheumatic fever with endocarditis; satisfactory recovery; well for four years; then began to complain of pain and stiffness in various joints; occasional swelling, some creaking, no fever. This condition persisted for about nine months under routine treatment.

This method was then tried and a vaccine prepared from subculture. After the first few inoculations she reported that she "felt a lot better." Treatment discontinued over a year ago. She has remained quite free from joint symptoms to the present time. Radiostoleum capsules were also given.

It was found desirable to examine two patients together, partly to economize time and partly to obtain sharply contrasting results; such results were obtained on several occasions. Statistics usually fail to leave a very vivid impression, but the contrast between one blood which gave a negative result in all tubes and the other which gave a profuse growth in No. 1 and No. 3, and hæmolysis with coagulation in No. 4, was even more impressive than the contrast between a negative and a strongly positive Wassermann reaction. One cannot doubt the significance of such a

contrast in two patients suffering from "eczema," and that it points the way to a more useful classification than is possible from external appearances alone. Nomenclature counts for too much in dermatology; underlying causes demand more attention.

Though this method does not afford *conclusive* evidence of intestinal infection, I think it might be employed with an expectation of establishing a *significant correlation* between certain intestinal microbes and certain types of skin and joint lesions eventually. Someone may ask what advantage that would be, and one may point out the following: (1) we should then have some exact and relevant knowledge, where now we have little besides speculation. Celsus said two thousand years ago that "Medicine is a conjectural Art." Matters have improved in the last fifty or sixty years, but it is certainly true that there has been little beyond mere conjecture hitherto in connection with the immediate problems under consideration; (2) a *significant correlation*, superseding conjecture, would doubtless lead to a more general scrutiny of the means at our disposal for modifying the intestinal flora, reinforcing the resisting power or achieving desensitization of patients hypersensitive to their intestinal bacteria or toxins—a by no means inconsiderable group.

In the meantime the method provides material in certain cases which is presumably more appropriate for the preparation of autogenous vaccines than material selected solely on speculative grounds. *A priori* expectations, however, are not always realized, and I shall not attempt to assess the value of the method at present. But one interesting feature of the vaccines prepared in this way may be mentioned: hypersensitiveness to very minute doses was encountered with quite unusual frequency in my experience. In a case of lupus erythematosus, for example, one two-thousandth of what would be an average dose

caused undoubted aggravation of the local discomfort. In another case of exceptionally irritable and intractable eczema, Dr. J. Walker (Preston) writes to me: "The hypersensitiveness had been overcome to some extent when the inoculations were discontinued. I think the patient's continued immunity from further attacks of the eruption is due to the cumulative effect of the prolonged vaccine treatment." He further expresses the opinion that "the nature of the reactions indicates that we were definitely dealing with the causative agent." That is also my own impression. It is a question, however, of obvious practical interest whether desensitization should be attempted by a prolonged series of very small doses or by a few comparatively large doses. In favour of the latter procedure is the experimental fact that a guinea-pig sensitized to a foreign protein, when given a large intravenous injection of the same protein, usually becomes refractory to another dose, if a fatal issue is averted. Of course, in these patients hypersensitive to intestinal bacteria or toxins, the condition is rather one of allergy than anaphylaxis, and, though there may be temporary inconvenience, there is, I think, no danger from a comparatively large subcutaneous dose.

The best method of desensitization, however, depending as it does on the interval between as well as on the size of the doses, must for the present be left to individual discretion and experience. An occasional dramatic result settles nothing. But if hospital physicians generally relied more on observation of groups, other groups under routine treatment alone acting as controls, and less on individual "clinical impressions," I think we should arrive more quickly at sound conclusions and in time be relieved from a good deal of the therapeutic conjecture still so prevalent.

In conclusion, may I suggest that what we call "health" is not a condition of equilibrium in which our resistance is at such a level as to afford steady

security against microbic invasion? It is rather a condition of oscillating equilibrium, the oscillations above or below the mean level being determined by a variety of factors, such as heat, cold, sunshine, fatigue and nutrition. From this standpoint the hypothesis of "showers of microbes" into the lymph or blood stream seems to provide an attractive explanation of transient febriculæ and perhaps of many even slighter ailments. The shower may be only a few drops or a deluge, and the result—a persistent septicæmia, localization of the infection, or possibly an almost immediate *restitutio ad integrum*.

My thanks are due to Dr. Lancashire, Senior Physician to the Manchester and Salford Skin Hospital, for the majority of the dermatological cases dealt with in this paper.

#### References

- <sup>1</sup> Dick, J. S. : *Brit. Med. Journ.*, 1928, ii, 773.
- <sup>2</sup> Cruickshank : *Ibid.*, 1928, ii, 555.
- <sup>3</sup> Green and Mellanby : *Ibid.*, 1928, ii, 691.
- <sup>4</sup> Colebrook, L. : *Ibid.*, 1930, ii, 134.

# The Use of Artificial Pneumothorax in the Treatment of Pleurisy in Pneumonia

By A. BRIAN TAYLOR, M.B., CH.B.

*Late House Physician, Hospital for Consumption and Diseases of the Chest, Brompton.*

THE employment of artificial pneumothorax in the treatment of pleurisy occurring in pneumonia is an attempt to reduce the mortality of one of the commonest and most fatal diseases that affect man, by relieving perhaps the most distressing symptom of the disease and thereby obtaining a more nearly optimum state in which the patient may resist and subdue the infection. It is agreed that the first and most important step in the treatment of a case of pneumonia is rest, in the fullest sense of the word—mental, bodily, and respiratory—and the chief feature of pleurisy is that the possibility of rest is almost entirely precluded by pain with each respiration, sharp and lancinating, stabbing through the patient's body, more intense on coughing and at the end of a deep inspiration.

The causation of the pain has been the subject of some discussion of recent years and has some relation to the treatment. For a long time it was thought that the rubbing of the inflamed layers of parietal and visceral pleura on each other caused the pain by irritating the nerve endings, and this view is supported by the presence of friction sounds over the site of the pleurisy and the relief of the pain when effusion supervenes. This is known as the friction theory; more recently Mackenzie<sup>1</sup> suggested the muscular



theory, that the pain was due to a hyperalgesia of the intercostal muscles. This, however, does not explain the variations of the pain in inspiration and expiration, and is based erroneously on the view that the parietal pleura is insensitive like the visceral. The third theory, known as the tension theory, was advanced by Bray<sup>2</sup> in 1926, and maintains that the stretching of the inflamed parietal pleura is the essential factor. This theory is supported by the inequality of the pain on inspiration and expiration, and that strapping the chest wall, by preventing stretching of the parietes, gives relief. The fact that the pain subsides when an effusion forms is open to three possible explanations.<sup>3</sup> The first and more obvious is the separation of the inflamed layers. Secondly, the pain of the acute congestive stage diminishes during the formation of œdema and the effusion, as the end organs of the sensory nerves in the pleura are released from pressure. Thirdly, the effusion, by causing lung collapse, diminishes the movement of the affected side and also the amount of stretching of the parietal pleura on inspiration.

As will be seen later, the presence of 500 c.cm. of oxygen in one pleural cavity will relieve the acute pain of dry pleurisy, although the layers may only be separated very slightly and without altering the state of the pleural membranes themselves or appreciably affecting the volume of the lung. Very often, however, some aching pain of a much less severe nature remains after the induction of the pneumothorax, and this suggests that the pain of pleurisy is a composite response depending on the friction of the surfaces as well as on the alteration of tension.

The distribution of pain sense in the pleura has been studied by Capps<sup>4</sup> in America, and his conclusions are of considerable importance in assessing the value of a pneumothorax in any particular case and in localizing the site of the affected pleura. He found that the

sensory innervation of the pleura in its various parts was as follows :—

Costal parietal pleura supplied by the intercostal, sympathetic and vagus nerves.

Visceral pleura supplied by the pulmonary plexus, originating in the vagus and sympathetic nerves and having no pain sense.

Pericardial pleura supplied by two delicate branches of the vagus nerve coming from the plexus pulmonary or cesophageal and probably by the phrenic nerve.

Diaphragmatic pleura supplied by the phrenic and intercostal nerves.

Pain may be elicited in the trachea and bronchial tubes, but very little pain sense is found in the parenchyma of the lung. The pain of pneumonia must be attributed to pleurisy, and the localization of this pain varies in different sites. Diffuse inflammation of the pleura tends to concentrate the pain in the lower part of the thorax rather than in the upper, and in the anterior and axillary regions than posterior. According to Schmidt<sup>5</sup> this is due to the greater excursion of the base and front of the chest, but also the anterior and lateral aspects show a greater sensibility to pain, which becomes localized there in a generalized affection. With a smaller and more defined area of pleurisy the pain is accurately localized over the place where the membranes are involved, owing to the intimate relationship between the costal pleura and the intercostal nerves. Therefore, in any measure aimed at dealing with the pleurisy locally, it is safe to be guided by the site of greatest pain, most hyperalgesia and most distinct friction sounds.

In dealing with diaphragmatic pleurisy, however, a different state is present, as referred pains at a distance are the signals of the disease, and there is no definite localization at the site of inflammation. Capps found that the central portion of the diaphragmatic pleura is supplied by the phrenic nerve for sensation, and the intercostal nerves supply the periphery in a band two or three inches wide anteriorly and forming a segment posteriorly of nearly a third of the membrane. Sensa-

tions of pain in the first group are referred to the neck, particularly along the borders of the trapezii and, according to Zachary Cope,<sup>6</sup> very frequently also in the infraclavicular fossa, through the descending cutaneous cervical nerves, which have a common origin with the phrenic nerve. Pain sensations from the periphery of the diaphragm, on the other hand, are referred to the lower thorax, the lumbar region, and the abdomen, and the localization of the exact position of the pain is usually vague.

Turning now to the practical side of the problem, the presence of pleurisy concurrently with pneumonia makes much more difficult the effective treatment of the lung condition. The patient is unable to take steady easy inspirations, for, just as he is filling his lungs, he is stabbed by a pang of pain. In the same way, instead of lying as restfully as may be, he turns and tosses in bed, constantly distressed and persistently awake. The physician is frequently forced to the use of some opium preparation to relieve this pain, in spite of the contra-indication by lung disease to that drug. Strapping the side of the chest, the usual and simple remedy for dry pleurisy, is quite out of the question in the presence of pneumonia; counter-irritants, such as leeches and pigments, are occasionally satisfactory, but are unreliable and not always effective. Poultices and similar applications should be avoided as restricting the respiratory excursion when the freest movement is vital. This painful symptom can, however, be at once and easily relieved by the injection of oxygen into the pleural cavity. The method was advocated by Morriston Davies for the treatment of dry pleurisy, and was first used by Professor W. H. Wynn<sup>7</sup> in cases of pneumonia. My own experience has been obtained with patients in Professor Wynn's wards. In this procedure a small quantity of oxygen is introduced into the pleural cavity, sufficient only to separate the layers without

appreciably collapsing the lung. The method used is the same as for any other artificial pneumothorax, except that the needle should be inserted where the pleurisy is most marked as evidenced by the loudest friction sounds and greatest pain. The use of a local anæsthetic is a *sine qua non*, as the inflamed state of the pleura makes it considerably more sensitive, and it is very desirable to avoid disturbing the patient more than necessary. Two per cent. novocain is therefore injected into the skin, chest wall, and especially the pleura, which latter minimizes the pain and the possibility of pleural reflex. A Riviere trocar and cannula are used for the induction. They are kept in alcohol, which is carefully burnt off before use, as it is essential that the lumen should not be occluded in any way and thereby impair the free flow of gas. The side tube of the cannula is connected to a graduated cylinder containing oxygen, which is forced through by running water into the bottom from another bottle. A manometer, attached by a T-piece between the cylinder and cannula, records the gas pressure in the cannula and in the chest. The trocar and cannula are pushed through the prepared and anæsthetized skin at the selected spot and the trocar is removed. The cannula is then forced onwards to the pleura, which gives suddenly, with a snap that is often audible. If the pleural surfaces are not adherent the manometer at once shows a negative pressure of 8 to 12 cm. of water, fluctuating 4 to 8 cm. with each respiration. No oxygen must be allowed to enter until this fluctuation of negative pressure is obtained, indicating that the pleural space has been reached. The introduction of about 250 to 500 c.cm. of oxygen is usually enough; this only slightly affects the intrapleural pressure; e.g. from  $-18$ ,  $-12$  cm. of water-pressure, 400 c.cm. of oxygen made it  $-14$ ,  $+4$  cm. of water; in another case,  $-12$ ,  $-8$  cm. of water became  $-4$ ,  $+3$  cm. of water with 400 c.cm. of oxygen; and by radiography

it is shown that it barely affects the volume of the lung.

As regards results, the pain is typically relieved almost completely, the relief appearing as the end of the induction is reached. Generally complete relief is obtained some minutes later, when the patient can settle down again, and it is then noticed that the respirations are slower and more regular, and he readily falls asleep. The pulse-rate nearly always slows by twenty or more beats per minute, and a corresponding improvement in the general condition is evident. The pneumothorax will last in most cases about three or four days, maintaining its effect, but a tympanitic note and diminished breath-sounds persist for several days. After a few days friction sounds often return, but as a rule are not accompanied by pleuritic pain. If, however, pain does recur, it is quite simple to refill the pneumothorax.

The best results obtained have been with pleurisy in the lower axillary region, where the ribs are well apart and the respiratory movement is greatest. This site is one of the commonest for pleurisy and is one of the easiest for inducing a pneumothorax. The following case is an example of this type :—

The patient, E. B., was a girl aged 21, who had had two attacks of influenza, a month and a fortnight, before admission to hospital. Three days before coming in she was seized with a bad stabbing pain at the base of the left chest, occurring with each breath. Cough and fever occurred concurrently. On admission on March 3, 1929, to the General Hospital, Birmingham, she had a temperature of  $104^{\circ}$ , a pulse-rate of 128, and respirations of 44 per minute. Her blood-pressure was 133/85 mm. of mercury, and she lay in bed obviously ill, but restlessly jumping about and taking only small, irregular, evidently painful, convulsive breaths, the pain of which was accentuated by coughing. The physical signs showed an area of pneumonia in the left lower lobe with a well-marked definite dry pleurisy in the axillary line about the level of the sixth and seventh ribs on the left side.

She was watched for six hours and received the usual routine treatment, but showed no signs of settling down or becoming comfortable, so at 10 p.m. 400 c.cm. of oxygen were introduced into the pleural cavity at the point where the loudest friction sounds were heard. The pressures at the beginning were — 12, — 8 cm.

of water, and became  $-4, +3$  cm. of water. At the same time 200 millions each of a stock vaccine of pneumococci, streptococci and influenza bacilli were injected. Within half an hour of completing the pneumothorax the patient was quietly sleeping; she did not wake till 6 a.m., and she had her crisis during that day, the fifth day of the disease.

In the next case the pleurisy was higher in the chest and nearer the front. In this situation an artificial pneumothorax is more difficult to induce and the pleural layers do not separate so readily. Relief from severe pain was, however, quickly obtained, and improvement in the pulse and blood-pressure were noted.

The patient, J. B., a youth aged 25, was admitted to hospital on March 1, 1929, on the fifth day of an illness consisting of malaise, cough, fever, and pain in the right side of the chest. He lay on his back obviously ill, flushed, sweating, and with herpes. The temperature was  $103.6^{\circ}$ , pulse-rate 112 per minute, and respirations 30 per minute. He had a short, sharp, hard cough, which he tried to suppress owing to the pain. Examination showed a consolidation of the right middle and lower lobes, and friction sounds were heard in the anterior axillary line over the third rib.

An artificial pneumothorax was induced on the right side, the needle being introduced in the mid-axillary line in the fourth intercostal space. 500 c.cm. of oxygen were run in, changing the pressure from  $-20, -16$ , to  $-10, -2$  cm. of water. As a result, in half an hour the pain and cough were almost entirely relieved and the patient was comfortable again after being severely distressed. His temperature fell by lysis on the eighth and ninth days and he made an uneventful recovery.

The third case was one of the most severe forms of pneumonia, causing persistent diaphragmatic pleurisy with intense pain:—

The patient, S. W., a woman aged 30, was admitted on the first day of the disease, June 27, 1929, with a temperature of  $104^{\circ}$ , a pulse-rate of 124, and respirations of 30 per minute, prostrated by acute pain in the right side of the chest, low down, and in the back. Signs of pneumonia were found with consolidation of the right lower lobe, but no friction was heard. A persistent, painful, distressing cough was very trying, and almost continuous pain at the right costal margin and in the right loin and back, evidently diaphragmatic in origin, prevented any prolonged rest.

For six days the patient was treated on orthodox lines, but failed to respond. On March 3, in view of the persistent pain and progressive deterioration, Professor Wynn induced an artificial pneumothorax on the right side, introducing the needle in the posterior axillary line in the sixth intercostal space. 500 c.cm. of

oxygen were run in and the foot of the bed was raised 12 in.

Very rapidly relief was obtained; the pain disappeared, the cough was eased, and the patient went to sleep. Her pulse dropped from 144 to 128 per minute and her breathing was much easier. Crisis occurred on the following day and recovery followed in due course, except for an interruption caused by an attack of acute pyelitis.

In this case the pleurisy was evidently situated posteriorly on the diaphragm in the area supplied by the intercostal nerves. The raising of the foot of the bed enabled the oxygen to run up to the base and separate the pleural surfaces, the lung tending to sink towards the neck. Radiograms in this case showed the pneumothorax distinctly as a thin layer near the base four days after the induction, but it was no longer recognizable after ten days. No recurrence of pain was noted as the oxygen was absorbed.

### References

- <sup>1</sup> Mackenzie : "Symptoms and their Interpretation."
- <sup>2</sup> Bray, H. A. : *Mer. Rev. Tub.*, 1926, xiii, 14-20.
- <sup>3</sup> McLaughlin, A. I. G. : "Observations on the Mechanism of Pleural Pain," *Lancet*, 1928, i, 489.
- <sup>4</sup> Capps, Joseph : "An Experimental Study of the Pain Sense in the Pleural Membranes," *Arch. Int. Med.*, 1911, 716.
- <sup>5</sup> Schmidt : "Pain," 1908.
- <sup>6</sup> Cope, Zachary : *Brit. Med. Journ.*, 1930, i, 895.
- <sup>7</sup> Wynn, W. H. : *Lancet*, 1922, ii, 493; *Birm. Med. Rev.*, 1926, i, 330; "Modern Technique in Treatment," vol. iii, 310.

# The Wisdom Tooth and Associated Troubles

By J. DUNLOP KIDD, M.C., M.B., D.M.R.E.  
*Honorary Dental Radiologist to the Tavistock Clinic,  
London.*

DURING the past decade, much has been written of the connection between dental sepsis and systemic disease, and it is unnecessary to emphasize the importance of such well-recognized facts, but other dental conditions give rise to general symptoms, and it is of these that this short note is written.

It is not uncommon for third molar teeth to develop in an abnormal position, i.e. horizontally or obliquely, and, when such is the case, there is a tendency for them to press upon the next tooth (the second molar). In such circumstances, any, or a number, of the following conditions may arise: neuralgia, persistent headache, stiffness or neuritic pains in the neck and shoulders, earache, ocular symptoms, general malaise, neurasthenia, fits, and even mild forms of mania. Most of the recognized textbooks on dental pathology mention such symptoms as possibilities, without, however, giving further details, and the view is mostly taken that some septic condition is necessarily present, in addition to the impaction.

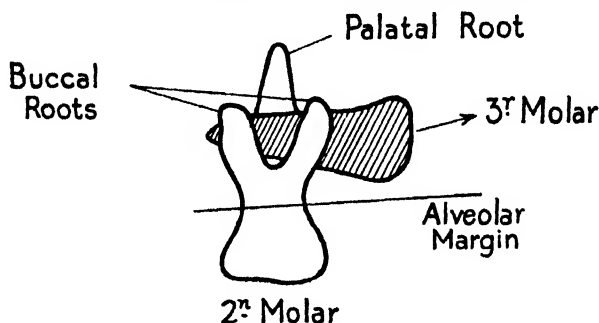
I consider the following case of sufficient interest to merit publication, as the symptoms appear to have been entirely due to the pressure of the impacted wisdom, without any accompanying dental sepsis:—

Mrs. X, aged forty, was sent to me for X-ray examination of her teeth, in the hope that some abnormality might be found to account for her obscure and varied symptoms. For about eighteen months she had not been "feeling well," and, during the same time, suffered from mild neurasthenia, chiefly characterized by irritability over trifles, a condition quite foreign to her nature. Recurrent headaches, getting rather more severe during the past



month, and vague neuralgic spasms in the left side of the face increased the neurasthenic symptoms. The eyes became "tired" after reading for an hour or so, but a careful ophthalmic examination did not reveal any errors of refraction or other abnormality. Weak reading glasses were recommended, and tried, but without relief. The final and most troublesome symptom, of about a month's standing, was an acute pain in the left shoulder and upper arm, aggravated by any upward movement of the arm to such an extent that she could not "do her hair." Radiant heat, etc., had given no relief.

An X-ray examination of the teeth showed that there were no apical abscesses, nor periodontal infection, and that the only abnormality was an impacted upper third molar. This tooth was lying horizontally, with the apex forward, and was impacted, the root lying between the palatal and buccal roots of the second molar



(see diagram). It was decided to relieve the impaction by extracting the second molar, not a practice to be generally advised, but the third molar was lying high, and its extraction would have entailed a rather extensive operation, to which the patient was very averse. This was done, and it was found that the impaction was so extreme that there was some actual erosion of the buccal roots on the lingual aspect, owing to the pressure from the root of the wisdom tooth. Forty-eight hours after the extraction, the pain in the shoulder and arm had completely gone, and now, some four months after, the neurasthenia and malaise have disappeared, the headaches and neuralgia have gone, and the eye symptoms have much improved. Mrs. X. now says that she is "feeling very well."

I am indebted to Mr. C. J. Tisdall, L.D.S., for the information regarding the condition of the second molar.

Impacted wisdom teeth are certainly the worst offenders, but other impacted teeth may cause somewhat similar conditions, and, if no other cause can be elicited, an X-ray examination may often clear up difficulties in diagnosis.

# Tuberculosis and Goats' Milk

By R. I. PITT, L.F.P.S.G., L.S.A.

I READ with interest the article on cows' milk by Lord Moynihan in the April, 1931, number of THE PRACTITIONER. The supply of pure milk is of the greatest importance to the general community and more especially to children, who in early infancy depend upon milk in some form for their entire sustenance. The article referred to treats entirely of cows' milk. I wish to bring to the notice of practitioners the value of goats' milk, which I think, up to the present, has not received the attention from the profession which it merits.

The properties of goats' milk compared with cows' milk give it a distinct advantage. In the first place goats are not subject to tuberculosis, so their milk is free from suspicion of that taint. As milk is derived from the blood of the animal secreting it, it is obvious that the immunity possessed should be transmitted through the milk, and that the immunity is due to some special immunizing property which accounts for its beneficial effects when supplied to tuberculous children, who are therefore taking milk not only free from the tubercle bacillus, but also possessing special immunizing properties. It is generally known that goats' milk is more digestible than cows' milk, and that children fed with it never vomit hard curds as they do when given cows' milk, but what they bring up is of a flocculent nature like the vomit of a child fed upon the breast. The nutritive value of goats' milk as demonstrated by analysis is quite equal to, and in many cases of well-fed goats superior to, that of cows. Its digestibility is demonstrated beyond argument when supplied to delicate and weakly

children. In my own experience I have known several weakly children who were unable to digest cows' milk thrive when supplied with that taken from a goat, and in the case of three premature babies (one only three and a half pounds at birth) grow up to be healthy children. From the above facts I think the goat should be more generally used as a milk supply in rural districts and especially at sanatoria, where the more able patients could be employed in looking after them, gaining experience in the management of animals and the benefit of a healthy occupation.

There is much prejudice against the use of goats' milk, which to a great extent is due to the prevailing impression that all goats have a disagreeable odour attached to them; this is quite erroneous; the female is absolutely free from any disagreeable smell, which only belongs to the male. This delusion is being combated by the British Goat Society and affiliated societies by instituting goat shows and supplying milk to the public, as is done at the British Dairy Farmers' Society exhibition, where goats' milk is supplied and is much appreciated. In my own house, people who declared they could not touch goats' milk were agreeably surprised to find how much it improved both tea and coffee and was free from any disagreeable flavour.

Goats are liable to infection by parasites, as are sheep and cows, and also to undulant fever (*Brucella abortus*), a microscopic infection which has been proved to be transmitted through the medium of cows' milk; so the goat cannot be considered the sole carrier of this disease.

Government has recognized the importance of this subject, and has granted financial assistance and advice by the Minister of Agriculture and Fisheries through the British Goat Society, by whom so much good work has been done in improving the breeds of goats by selection of the best types to breed from, and

has so much improved them that their period of lactation is now considerably prolonged, and the best goats now give considerably over a gallon of milk in 24 hours, some as much as a gallon and a half; the ordinary wayside or common goat gives from three pints to two quarts or a little over in the 24 hours. Several goat societies now affiliated with the British Goat Society are carrying on the good work and helping cottagers to acquire goats in order that their families may be supplied with pure milk, of which many are in great need and unable to procure. As a goat is so easily and economically kept by a cottager in country districts, it is surprising this source of milk supply is not more often resorted to by them.

As I have stated above, the immunity of goats from tuberculosis specially fits them for supplying milk to sanatoria patients, and perhaps the British Goat Society and its affiliated members might be induced to supply a small herd to some sanatorium. Perhaps Papworth might be considered a suitable place to begin with. There they have plenty of space, are training patients in several industries and would no doubt have no difficulty in training some to attend to the goats, which would provide an interesting outdoor occupation. They have the open spaces there, and in the village many children of patients, and both children and parents would be greatly benefited by the use of goats' milk.

# Practical Notes

## *The Treatment of Fibroids of the Uterus.*

H. H. Schlink and C. L. Chapman consider that in the case of most fibroids of the uterus treatment should be surgical. They believe in: (1) The vaginal removal of most pedunculated sub-mucous fibroids; (2) Myomectomy in selected fertile cases; (3) Total hysterectomy for certain cervical fibroids or cases complicated with malignant disease; (4) Porro's hysterectomy following Cæsarean section in certain cases of fibroids complicating pregnancy; (5) Sub-total hysterectomy with endocervical enucleation for all other cases. Radiotherapy should only be used: (1) In cases in which the tumours are relatively small and uncomplicated by degeneration or diseased appendages, cases, that is, in which the symptoms closely simulate the myopathic uterus (chronic metritis) by causing the postponement of the menopause with severe bleeding after forty; (2) In cases of uncomplicated fibroids requiring treatment, but in which considerations of general health contra-indicate operation; for example, cardiac and renal disease, Graves's disease, diabetes, pulmonary tuberculosis and other respiratory complications and, finally, dread of operation; (3) As an alternative to blood transfusion in cases of profound secondary anæmia to render the patient fit to stand radical curative measures.—(*Medical Journal of Australia*, June 6, 1931, xviii, i, 691.)

## *The Action of Irradiated Ergosterol and its Relationship to Parathyroid Function.*

N. B. Taylor and C. B. Weld with H. D. Branion and H. D. Kay have carried out at the University of Toronto a number of experiments from which fresh evidence has been derived for a close relationship between the overdosage effects of irradiated ergosterol and parathyroid function. This relationship is thought to be most probably a direct one, namely, the stimulation of parathyroid tissue by the sterol. Death of adult dogs follows the administration of irradiated ergosterol when the amount given per kilo has a greater potency than 20 times that of the maximal therapeutic dose. Puppies show a greater susceptibility to overdosage than full-grown animals. The symptoms and post-mortem findings in the blood following overdosage with irradiated ergosterol are indistinguishable from those resulting from the administration of lethal doses of parathormone. The chemistry of the blood, in so far as this has been investigated, is affected in an almost identical manner by either substance. The effects of excessive doses of irradiated ergosterol upon calcium and phosphorus metabolism run closely parallel with those resulting from parathyroid overdosage. It is pointed out that those species which show a high resistance to the toxic action of irradiated ergosterol are tolerant to a corresponding degree to the action of parathormone. Since the dog and the human subject are, as contrasted with other species, highly susceptible to

the hormone, it is suggested that the human subject may share with the dog a high susceptibility to irradiated ergosterol. Clinical observations are cited as direct evidence for the latter view. The authors' experiments and those of others indicate that, upon increasing the dosage of irradiated ergosterol from small to very large amounts, its effect upon calcium metabolism becomes reversed, a parathormone-like action becoming manifest. The precise level of dosage at which the reversal of action occurs is unknown.—(*Canadian Medical Association Journal*, July, 1931, xxv, 20.)

### *The Treatment of Derangement of the Cartilages of the Knee-joint.*

L. A. Lantzounis publishes a report on a study of end-results in 142 cases of derangement of the cartilages of the knee-joint treated by operation. He states that an untorn, hypermobile meniscus is a definite entity. A deranged meniscus may occur in an arthritic joint or may be the inciting cause of arthritis on account of the constant mechanical irritation. The presence of arthritis in a knee joint, complicated by a deranged meniscus, does not constitute a contra-indication for operation, and the symptoms may be greatly relieved by removal of the meniscus. Removal of one or both menisci does not result in an unstable knee joint. The removal of an offending meniscus by operation is a better procedure than any prolonged conservative method of treatment. The relief of symptoms in uncomplicated traumatic lesions of menisci is uniformly complete following removal of the meniscus.—(*Surgery, Gynecology and Obstetrics*, August, 1931, liii, 182.)

### *Pantocain, a New Local Anæsthetic.*

Lundy and Essex, of the Division of Experimental Surgery and Pathology, The Mayo Clinic, have made experimental and clinical observations on pantocain (butylamino-benzoic acid B. dimethyl-amino-ethylectermonohydrochloride) which chemically and clinically resembles procain, but is effective in a dose of one-fifth to one-tenth and produces an anæsthesia two or three times longer. For spinal anæsthesia one milligramme of pantocain for each 10 lbs. of body weight, plus 5 mg., is the dose for adults, a 0.5 per cent. solution being employed. In order to support the blood-pressure during spinal anæsthesia intramuscular injection of 25 to 50 mg. of ephedrine has been shown to be useful. Pantocain is best adapted for operations to cure ventral hernia and gastro-gegnal ulcer, in resection of the stomach and lumbar sympathetic gangliosectomy. It has been found to be three or four times less toxic than nupercain, a derivative of quinine ( $\alpha$ -butylaxycinchoninic acid diethyl-ethylene diamide hydrochloride), as a spinal anæsthetic.—(*Proceedings of Staff Meetings of The Mayo Clinic*, June 24, 1931, vi, 376.)

### *Atony of the Gall-Bladder.*

In an article on black biles, Chiray, Pavel, and Amy describe the condition of cholecystatony in which from muscular weakness the

gall-bladder, although there is not any mechanical obstruction, becomes distended with bile, which from over-concentration becomes very dark and contains an excess of biliary pigments, bile acids and cholesterol. Associated with this condition of the bile in the gall-bladder there are the following symptoms: digestive vagotonia, biliary dyspepsia, and often a special form of migraine. The existence of the gall-bladder condition can be shown by cholecystography, as, indeed, Graham, Cole, Copher, and Moore have demonstrated, and by Lyon's method of medical drainage of the biliary tract. This condition of biliary stasis and the attendant symptoms can be benefited by Lyon's medical drainage, and the operation of temporary cholecystotomy is not necessary.—(*Presse médicale*, July 4, 1931, 988.)

### *The Value of Skin Tests and Immunization against Scarlet Fever and Diphtheria.*

P. S. Rhoades carried out skin tests and immunization against scarlet fever and diphtheria among the nurses of Cook County Hospital, Chicago, with the following results. The Dick test proved to be a reliable indicator of immunity to scarlet fever. No cases developed among 533 nurses found immune on original tests, while fifteen cases occurred during the same period among 449 nurses who either were Dick positive or were neither tested nor immunized. Immunization with five doses of scarlet fever toxin of 500, 2,000, 8,000, 25,000 and 80,000 skin test doses respectively was successful. No cases of scarlet fever occurred among 298 nurses who received the full series of immunizing doses, while there were fourteen cases during the same period among 449 nurses who received no immunizing doses from the Scarlet Fever Committee and one case in a nurse who had received three doses but had not had her fourth and fifth immunizing doses. Among the 190 nurses immunized against scarlet fever, the total loss of time due to reactions from the immunizing doses was 45.5 days, an average of 0.239 day per nurse.

The results of immunization against diphtheria with five doses of toxin-antitoxin of tested potency and with diphtheria toxoid followed by retests and more doses when indicated were distinctly better than those previously reported when only three doses of toxin-antitoxin were used. Three cases of diphtheria occurred among 141 nurses who received five or more doses of diphtheria toxin-antitoxin of tested toxicity. One case of diphtheria occurred in a group of 424 nurses who received a full series of doses (totalling 2.5 c.cm. or more) of diphtheria toxoid. During the same period there were eighteen cases of diphtheria among 550 nurses with identical exposures who were either not immunized at all or who received less than the full series of diphtheria toxin-antitoxin or toxoid. Two cases of diphtheria occurred among 165 nurses who had negative original Schick tests. It is probable that an impotent preparation of Schick test toxin was used for these tests. Nine preparations of Schick test material were tested simultaneously. Two commercial preparations gave negative results in all persons tested, while all the others gave positive results in the same persons.

Complete series of diphtheria toxoid (totalling 2.5 c.cm. or more)

immunized 81·4 per cent. of the nurses to the point of a negative Schick test, while five doses of a preparation of toxin-antitoxin of tested toxicity (totalling 4·5 c.cm.) used in a similar group immunized 64·4 per cent. to this point. Three hundred and sixty-one nurses who received diphtheria toxoid lost a total of forty-eight days from duty because of reactions, an average of 0·133 day per nurse.—(*Journal of the American Medical Association*, July 18, 1931, xcvi, 153.)

### *Bovine Tuberculosis in Man.*

This memorandum on bovine tuberculosis in man with special reference to infection by milk shows that, although it is not possible to give the proportion of the cases of bovine tuberculosis in man, probably more than a thousand deaths under the age of 15 years in England and Wales are annually due to this infection, and for some forms of tuberculosis, namely, lupus and cervical adenitis, half the cases at all ages are due to bovine infection. It is, of course, practically certain that the great majority of human infections with the bovine tubercle bacillus are due to milk, and there is reason to believe that the proportion of milch cows in this country actually yielding tuberculous milk is probably between 1 and 2 per cent. Complete eradication by means of universal tubercular testing and the slaughter of all the reacting animals is not practicable in this country, but a less drastic procedure aiming at the destruction of animals in an advanced and more infectious stage is represented by an order of the Ministry of Agriculture and Fisheries, 1929. Calmette and Guérin's claim to prevent tuberculosis in young calves by protecting them with their vaccine B.C.G. has not yet been established for human babies.—(*Reports on Public Health and Medical Subjects*, No. 63, Ministry of Health, 1931, pp. 25, price 6d.)

### *Carcinoma of the Naso-pharynx.*

Digby, Thomas, and Hsiu analysed 103 cases of carcinoma of the naso-pharynx seen in the Surgical Unit, University of Hongkong, since 1914. The disease is much commoner in China than in Great Britain; it attacks males three times more often than females, and is most frequent comparatively early in life, 31–35 years. It appears in various guises and is often diagnosed wrongly in its early stages; most commonly it presents the picture of enlarged upper deep cervical glands on both sides, though those on one side are usually affected before those on the other. Some cases have probably been regarded as lympho-sarcomatous, tuberculous, or syphilitic involvement of the gland in the neck. The tumour is an atypical spheroidal-celled carcinoma, which, besides spreading to the lymphatic glands, may invade the orbit, causing proptosis, or the skull, involving various cranial nerves and producing strabismus, blindness, paralysis, muscular atrophy, severe pain, deafness, and tinnitus. The primary growth, which, of course, should be removed as soon as possible, may, unfortunately, be very inconspicuous for a long time, and, being merely a fissure or an induration, may be missed when examination with an ordinary nasopharyngoscope is carried out.



An attempt to provide a more satisfactory form of instrument is being made by the authors.—(*The Caduceus*, Hongkong, May, 1930, ix.)

### *The Nature of the Toxic Agent in Eclampsia and the Nephrosis of Pregnancy.*

F. Hoffmann and K. Anselmino have brought forward clinical and experimental evidence to support their contention that the substance in the blood of pregnant women suffering from eclampsia or nephrosis is identical with the hormones secreted by the posterior lobe of the pituitary. Filtrates from the blood of women with either of these two dreaded complications of pregnancy, when injected subcutaneously into rabbits, greatly diminished the amount of urine subsequently secreted. In those cases in which the blood pressure of the patient was considerably raised, injection of the filtrate from the blood produced an appreciable rise also in the blood pressure of animals. Similar injections from cases of uncomplicated pregnancy or from non-pregnant women had no effect on the blood pressure of rabbits. From the results of their experiments Hoffmann and Anselmino submit that the primary factor in the production of eclampsia and the nephrosis of pregnancy is a disturbance of the organs of internal secretion which leads to an uncompensated over-production of both the anti-diuretic and vaso-compressor components of the hormone of the posterior lobe of the pituitary body.—(*Klinische Wochenschrift*, August 1, 1931, 1438.)

### *The Incidence of Cancer of the Urinary Bladder and Prostate in Certain Occupations.*

S. A. Henry, N. M. Kennaway and E. L. Kennaway find from examination of 12,403 death certificates from England and Wales during the period 1921–1928, both included, that 5,621 men died from vesical cancer, 974 from papilloma of the bladder, and 5,808 from malignant disease of the prostate. Analysis of the cases from 46 occupations shows that in eight out of the ten occupations associated with exposure to coal gas, tar, pitch or soot the incidence of cancer of the bladder is greater than that found in the general population, and that tar distillers, gas-works engine and crane drivers, and patent-fuel labourers have the highest incidence; of these three occupations the tar-distillery workers show a low and the patent-fuel workers a fairly high incidence of prostatic cancer. A comparison of the incidence of cancer of the bladder on the one hand and of cancer of the scrotum and other parts of the skin on the other hand suggests the idea that the skin serves as a very effective first line of defence to the urinary tract; occupational cancer of the bladder is absent in shale-oil workers and sweeps who suffer from scrotal carcinoma; but the authors are careful to admit that the substances producing carcinoma of the skin may be different from those which cause cancer of the bladder. The analysis of the data about prostatic cancer gives less consistent indication of an occupational liability than in vesical malignant disease.—(*Journal of Hygiene*, Cambridge, 1931, April, xxxi, 125.)

# Reviews of Books

*Recent Advances in Radiology.* By PETER KERLEY, M.B., Ch.B., D.M.R.E. London: J. & A. Churchill, 1931. Pp. viii and 324. Illustrations 120. Price 12s. 6d.

DR. PETER KERLEY has made it his business to produce a readable book on up-to-date radiology for the general practitioner—and books on radiology that are readable so far as the general practitioner is concerned are very few—and in this intention he has certainly succeeded. He has been well seconded by his publishers, for the book is lavishly illustrated with excellent radiograms and a number of unusually clear and understandable diagrams. Not all of the sections of the book are, however, equal in merit; the section on the alimentary canal could not be better done or better illustrated, but the section on X-ray therapy is disappointing and the section on the genito-urinary tract is frankly inadequate. This last section illustrates the difficulty of producing a series of books on “recent advances,” for by the time the book was published the part devoted to the genito-urinary tract had become out of date, as there is only a mere mention of intravenous pyelography. And, although the general practitioner is well catered for, the practising radiologist would have liked more space devoted to recent advances in technique, instead of being referred to original articles elsewhere. Nevertheless, the author and the publishers alike may be congratulated on this latest addition to a series unparalleled among medical publications.

*Heart Disease.* By PAUL DUDLEY WHITE, M.D., Physician, Massachusetts General Hospital, Boston. New York: The Macmillan Co, 1931. Pp. xxii and 731. Illustrations 119. Price 42s.

THE enormous advance in our knowledge of the cardio-vascular system within the present century is strikingly shown in this encyclopædic review of the subject, which has a bibliography occupying more than 180 pages, and a subject index extending over 44 pages of smaller type. It is interesting to compare it with Sir Byrom Bramwell's book on “Diseases of the Heart and Thoracic Aorta,” published in 1884. In addition to diseases of the heart, those of the vascular system, including the capillaries, are summarized, and aneurysm and such a rare condition as periarteritis nodosa are described. This volume is the outcome of many years' work and the examination of twelve thousand patients as well as a wide survey of the literature. It is divided into four parts: the first deals with the examination of the patient and analysis of signs and symptoms; the second, with the etiological types and causes of heart disease; the third, with organic lesions of the heart and great vessels; and the fourth, with the disorders of cardio-vascular function. Angina pectoris is considered in the last part and is regarded as probably due to some, though not always the same, form of coronary change; but in addition to coronary insufficiency a high nervous constitution is invoked, for a sensitive person may have angina, though there is little morbid change, and an insensitive individual much in the way of pathological lesions,

but no angina. In an appendix there is a list of 108 problems awaiting solution in cardio-vascular diagnosis and treatment. In conclusion, this must be regarded as a valuable source of reference.

*Injuries and Sport.* By C. B. HEALD, C.B.E., M.D., M.R.C.P. Oxford University Press. London: Humphrey Milford, 1931. Pp. 543. Illustrations 380. Price 25s.

THE treatment of injuries sustained whilst taking part in the many varieties of sport to which the public devote themselves at the present day has not always been all that could be desired, chiefly because the patient in so many instances does not know quite what has happened. The object in writing such a book as this is therefore an admirable one. It is very well produced, and the many illustrations showing the various attitudes which may lead to injuries in different types of sport are excellent. The treatment of muscle and tendon injuries is in many textbooks passed over in so very superficial a manner, that practitioners start work with a very scanty knowledge of these lesions, and the author has here supplied in a very clear way what is necessary. But the sections devoted to the treatment of fractures seem rather out of proportion. Many of these fractures must be very rare accidents in any kind of sport, and the general impression left is that they are overtreated. Some of the methods of splintage are cumbersome; for example, that of a Colles fracture. The method of splinting this fracture as described by the author cannot be compared for efficiency or simplicity with the use of plaster fixation, which allows free movement of the fingers and thumb. In the treatment of fractures of the shaft of both bones of the forearm with displacement the author advocates an attempt at reduction. If this is not satisfactory he suggests that the arm should be treated for three or four days by direct current before a further attempt is made, and that if this fails a surgeon should be called in. This is a dangerous doctrine to preach. The sooner a fracture is reduced either by manipulation or open operation the better. Muscle spasm and swelling bear a direct relationship to the degree of displacement and the time that it has been present. The old idea that a recurrent dislocation of the shoulder is due to weak muscles is repeated. Recurrent dislocation of the shoulder only recurs in patients with good muscular development. The author's enthusiasm for anodal galvanism colours his treatment of most injuries; in his own hands it may well prove of very great value, but the busy practitioner has hardly time to give all the injuries he meets with electrical treatment.

*Notes on Radium Therapy for Medical Students.* By HECTOR A. COLWELL, M.B., Ph.D. London: H. K. Lewis & Co., Ltd., 1931. Pp. xi and 165. Illustrations 15. Price 6s.

WRITTEN by an authority with long experience these clearly-expressed notes meet a want frequently felt by medical practitioners; in fact, just the points on which the reader may want further information are anticipated and supplied, for example, in the footnotes to the "Recommendations of the X-ray and Radium Protection Committee." The first twenty-two pages of the book are devoted to a summary of the physics concerned. After discussing

generally the therapeutic effects of radium and radon, the treatment of malignant disease of various parts of the body is described; separate chapters deal with malignant disease of the breast, tongue, œsophagus and larynx, the rectum, cervix uteri, and urinary bladder. In addition, irradiation of rodent ulcers, other cutaneous carcinomas, and sarcomas receive due notice. This is a very useful and handy guide to the subject.

*Calcium Metabolism and Calcium Therapy.* By ABRAHAM CANTAROW, M.D., with a foreword by HOBART AMORY HARE, M.D., LL.D. Philadelphia: Lea and Febiger, 1931. Pp. 215. Illustrated. Price \$2.50.

The subject of calcium metabolism and treatment is one of great topical interest, and a summary of the present state of knowledge, such as is here provided in a convenient form, will be welcomed by many medical readers. The information is conveyed in three parts, dealing respectively with normal calcium metabolism, the disorders of calcium metabolism, and their treatment. The methods of administration—oral, subcutaneous, and intramuscular, and intravenous—are discussed, and it is definitely stated that the quantities of calcium salts ordinarily prescribed to be taken by the mouth are quite inadequate; the tasteless calcium gluconate, introduced by Sandoz, should be given in dram doses three or four times daily to adults, and the dose for children calculated on the basis of the body weight. In addition to a chapter on the treatment of tetany there is one on non-specific calcium therapy. A useful bibliography occupies 15 pages, and there is a good index.

*Materia Medica, Pharmacy, Pharmacology and Therapeutics.* By SIR WILLIAM HALE-WHITE, K.B.E., M.D., LL.D. Twentieth edition. Revised by A. H. DOUTHWAITE, M.D., F.R.C.P. London: J. and A. Churchill, 1931. Pp. viii and 712. Price 10s. 6d.

It is nearly forty years since 1892, when Sir William Hale-White brought out this, the first edition of his well-known work, and now, just before it comes of age, he hands to his successor the torch which has lighted the path of many generations of medical students. The general features remain much as they were; a number of additions have necessarily been made, among which ephedrine, avertin, sodium tetraiodophenolphthalein, uroselectan, measles convalescent serum, and parathormone may be mentioned to assure the reader that the twentieth maintains the tradition of the previous editions. The new edition of the British Pharmacopœia may be expected to be out before the next edition of this familiar handbook is due, and no doubt this will entail a considerable number of alterations.

*The Treatment of Chronic Deafness.* By GEORGE C. CATHCART, M.A., M.D. Second edition. London: Humphrey Milford, Oxford University Press, 1931. Pp. 111. Illustrations 7. Price 5s.

In this book Dr. George Cathcart sums up the results of his treatment of deafness by the electrophonoïde method of Zund-Burguet. In this method an electrical instrument, the electrophone, is employed to "re-educate" the hearing by reproducing the sounds

of the human voice in all its registers and at the same time stimulating the ears by a short-wave oto-massage. In Dr. Cathcart's hands this method has given very good results, 429 cases, or 64.5 per cent., having improved out of a total of 665 cases of chronic progressive deafness. Although the method is one which has not been taken up by otologists in general, Dr. Cathcart's arguments for it seem overwhelming; he publishes all his cases, successful and unsuccessful, and, although he is obviously an enthusiast, his presentation of the case for the method is restrained and convincing.

*The Modern Therapeutics of Internal Diseases: An Introduction to Medical Practice.* By A. P. CAWADIAS, O.B.E., M.D., M.R.C.P. London: Baillière, Tindall and Cox, 1931. Pp. xi and 147. Figs. 3. Price 10s. 6d.

THIS work deals with the philosophical aspects of treatment, and is not, as the reader of the title might imagine, an index of diseases with a description of the most up-to-date remedies. It is therefore more likely to appeal to the thoughtful practitioner than to those anxious to be put wise in a hurry about methods of cure and relief. While firmly convinced that treatment is the all-important duty of the medical man, the author regards its present practice as unsatisfactory and ascribes this failure to three causes: these are the lack of complete and synthetic knowledge of the science of medicine, the incompleteness of the usual diagnostic procedures, and the one-sidedness and blindness of the application of therapeutic agents. The first third of the volume is devoted to a critical consideration of the fundamental concepts of medical science on which the treatment of internal diseases is based; this is followed by an account of "the first phase of treatment of an individual suffering from an internal disease," namely, diagnosis, and then by the second phase—the application of remedies and the description of their actions. In a chapter on "the Modern Internist" stress is laid on the value of a classical and philosophical education, and Professor Brouardel, Dean of the Paris Faculty of Medicine, is quoted to the effect that students with an exclusively scientific or modern preparation never become such good physicians as their classical colleagues. Against specialization on diseases of one organ or system of the body Dr. Cawadias has a good deal to say, and insists that "internal medicine is all or none." This book is the result of much thought and therefore deserves attention from those who look for advance in scientific treatment.

*Recent Advances in Medicine: Clinical, Laboratory, Therapeutic.* By G. E. BEAUMONT, D.M., F.R.C.P., and E. C. DODDS, M.V.O., M.D., Ph.D. Sixth edition. Recent Advances Series. London: J. and A. Churchill, 1931. Pp. xiv and 442. Illustrations 51. Price 12s. 6d.

THE demand for this successful handbook is shown by the number of editions, nearly one a year, since it originally came out in 1924. The present edition has exactly the same number of pages as the fifth, two years ago, but has been thoroughly revised and brought up to date. In the account of the treatment of pernicious anæmia (a stomach deficiency disease) by stomach preparations it is sugges

that the relation between stomach extract on the one hand and liver extract on the other, is that the stomach manufactures a substance which passes to the liver to be stored there and to a lesser extent in the spleen and kidneys. Other additions deal with basal metabolism and the Aschheim-Zondek test for the detection of early pregnancy.

*The Note-book of Edward Jenner, with an Introduction on Jenner's Work as a Naturalist.* By F. DAWTREY DREWITT, M.D., F.R.C.P. Oxford University Press, 1931. Pp. vii and 49. Plate 1. Price 3s. 6d.

THIS note-book, presented to the Royal College of Physicians of London in 1888, is now published for the first time in a very charming setting, both of the type and of the introduction by a true nature-lover. Jenner had few of the common ambitions, but showed "the generosity of a good man and the simplicity of a great one." As a naturalist his fame mainly depends on careful observation of the immoral lives of the cuckoo, mother and offspring; the mother is capable of laying twenty-six eggs in one season, and each female cuckoo haunts more or less the same kind of victim, and her eggs resemble those of her victim, except in the case of the hedge-sparrow. Jenner showed that the young cuckoo and not the parent removes the eggs from the nest in which they were deposited. He also investigated distemper in dogs, and recorded many instances of hydatid disease in animals.

*Recollections of an Old and Observant Practitioner.* By JOSEPH DANIEL McFEELY, F.R.C.S.I., J.P. London: E. O. Beck, 1931. Pp. 246. Plate 1. Price 7s. 6d.

IN the account of his "life and its warnings" the author tells a number of good stories and strange adventures as a general practitioner in various Irish villages and in Liverpool, and, between these two periods, as senior surgeon to Mercer's Hospital, Dublin, for seven years. The Ireland he describes is very different from that of the present day. This autobiography occupies half the volume. It is often regretted that the information, diagnostic and therapeutic, obtained by general practitioners as the result of long experience all too frequently dies with them. In the second part of this volume the author breaks such a silence, and reverts to the method he described in 1902 of applying formalin to superficial malignant growths and thereby leading to disintegration of the neoplastic cells. There are a number of other remedies in which he had great faith, such as salicylate of sodium, as a specific for tuberculous pleuritic effusion, and as a preventive and to some extent a cure for rheumatic endocarditis.

*The Physical and Radiological Examination of the Lungs: with special reference to Tuberculosis and Silicosis, including a Chapter on Laryngeal Tuberculosis.* By JAMES CROCKET, M.D., F.R.C.P.E. 2nd ed. London: H. K. Lewis & Co., 1931. Pp. x and 296. Plates 40. Illustrations 111. Price 16s.

THE above is the full title of the book reviewed last month (318) under the title of "The Physical and Radiological Examination."

# Preparations and Invention

## LACARNOL

(London : Messrs. Bayer Products, Ltd., 19, St. Dunstan's Hill, E.C.3.)

Lacarnol is an extract of the muscle tissues which is said to exert a selective dilator action on the coronary arteries. Its use is suggested primarily in angina pectoris and such vascular disease as are due to spasm of the arteries. Even where arterio-sclerosis is present lacarnol may improve markedly the general well-being of the patient by increasing the capacity for work and the body's power of functioning. It is administered in the form of drops, 10 to 25 to be given one to three times daily on a piece of sugar, and may also be given intramuscularly if desired. When an attack of angina pectoris is in progress  $\frac{1}{2}$  to 1 c.cm. of lacarnol solution, as prepared in ampoules, may be given intravenously. It is issued in drop-bottles containing 20 c.cm. and in ampoules of 1 c.cm. in boxes of five.

## GLUCOSE-D.

(London : Glaxo Laboratories, 56 Osnaburgh Street, N.W.1.)

Glucose-D is a high-grade powdered glucose (98 per cent.) with the addition of vitamin D and a compound of calcium and phosphorus. The idea of this combination is that as the low fat diets necessary in acidosis are deficient in vitamin D, and generally in calcium, their addition to the glucose compensates for the deficiency in addition to giving a certain amount of tonic property to the preparation. The suggestion of adding vitamin D, calcium and phosphorus to glucose for the treatment of acidosis certainly seems a sound one to us, and the preparation should prove valuable in practice, both for children and for adults.

## NEW HANOVIA MODELS

(Slough : The British Hanovia Quartz Lamp Co., Ltd.)

The Hanovia Company announce that their well-known standard Alpine sun lamp has been redesigned, and coupled with improved mechanical efficiency it gives considerably increased output. It has a new chromium reflector, which with improved burner design increases the effective ultra-violet output by 30 per cent., while the new operatometer gives the practitioner simple guidance as to correct treatment conditions with the lamp. Further, facilities are provided for the addition of a Sollux lamp on the same base, so that the practitioner can administer simultaneously or separately both ultra-violet and luminous heat radiation.







INDIAN AGRICULTURAL RESEARCH  
INSTITUTE LIBRARY, NEW DELHI

[illegible]